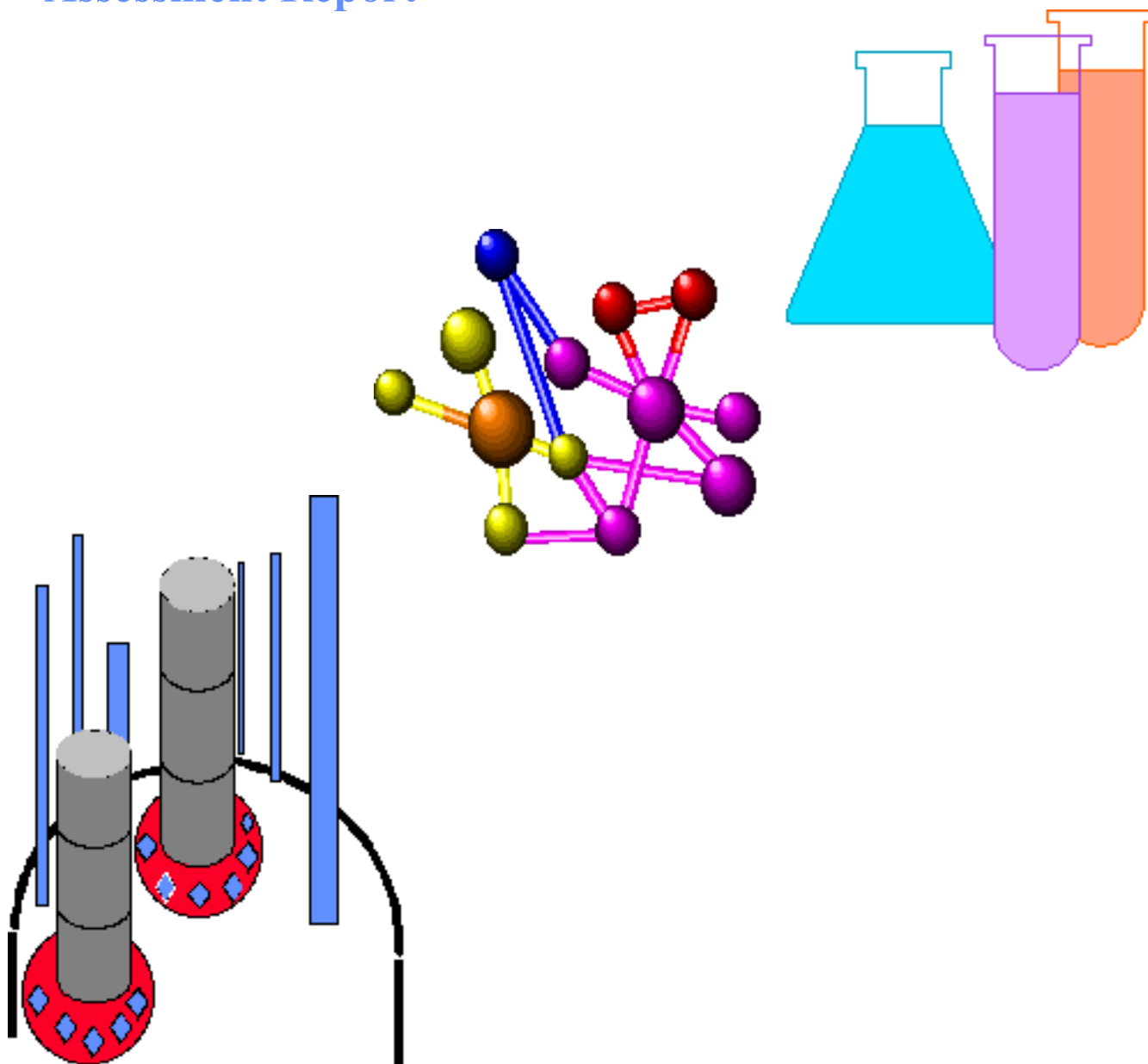




Chemicals and Allied Products Industry Hazardous Waste Source Reduction Planning Assessment Report



Pete Wilson, Governor
State of California

Peter M. Rooney, Secretary
California Environmental Protection Agency

Jesse R. Huff, Director
Department of Toxic Substances Control

California Environmental Protection Agency
Department of Toxic Substances Control
Office of Pollution Prevention and
Technology Development

April, 1998

**California Chemical and Allied Products Industry
Hazardous Waste Source Reduction Planning Assessment Report**

Prepared by David Weightman

**State of California Department of Toxic Substances Control
Office of Pollution Prevention and Technology Development
April 1998**

This report was prepared by David Weightman under the direction of Alan Ingham and Kim Wilhelm, Source Reduction Unit, Office of Pollution Prevention and Technology Development.

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- | | |
|--|--|
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| 2) Air Products and Chemicals | 32) Proctor and Gamble |
| 3) Allied Signal | 33) Rhodia (formerly Rhone Poulenc) |
| 4) Alpha Therapeutic | 34) Roche Bioscience |
| 5) Alza Corporation | 35) Schumacher of Air Products and Chemicals |
| 6) Amgen | 36) Star Pacific |
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| 21) GNB technologies | |
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| 23) Kelco | |
| 24) Lonza, Inc. | |
| 25) MD Pharmaceuticals | |
| 26) Monsanto - Avon facility | |
| 27) Morton Electronic Materials | |
| 28) Nalco Chemical | |
| 29) North American Chemical Company | |
| 30) Perkins-Elmer, Applied Bioscience Division | |

DISCLAIMER

The mention of any products, companies, or, source reduction technologies, their source or their use in connection with material reported herein is not to be construed as either an actual or implied endorsement of such products, companies or technologies.

REPORT OVERVIEW

This report discusses the Department of Toxic Substances Control's (DTSC) findings based on a review of hazardous waste source reduction planning documents prepared by 40 California facilities that are classified as Chemicals and Allied Products firms in the federal Standard Industrial Classification system (SIC) codes. Additional information in this report was gathered through site visits, discussions with facility personnel, and from researching industry trade journals. These documents were prepared to fulfill the requirements of the Hazardous Waste Source Reduction and Management Review Act also known as SB 14 (see Background section of this report). Several types of facilities are represented in this report including firms that make catalysts, agricultural chemicals, detergents, food additives, cosmetics, and other inorganic and organic chemicals. Many of the specialty chemicals produced by chemical firms are intermediate products used as raw materials to produce downstream products. Firms that make pharmaceutical and biological products are also represented in this report and are discussed as a subgroup. This review does not address polymer and resin firms classified under SIC codes 2821, 3086, or 3087, paints and coatings (SIC code 2851), or petroleum refining and exploration sites. These types of operations have been addressed in previously produced DTSC publications 531, 533 and 535.

This report includes background information on SB 14, and an overview discussion regarding SB 14 compliance problems and source reduction barriers and opportunities for chemicals and allied products manufacturing firms. It also provides company profiles that include business descriptions, and waste generation and source reduction information gleaned from document reviews. The report indicates facilities which reported under the 1996 Toxic Release Inventory system specified in the federal Emergency Planning and Right-to-Know Act, and prepared U.S. Environmental Protection Agency (EPA) 1995 Hazardous Waste Reports. In addition, one facility-specific case study is featured.

California's Hazardous Waste Source Reduction and Management Review Act of 1989 (SB 14) applies to generators that routinely produce in excess of 12,000 kilograms of hazardous waste or 12 kilograms of extremely hazardous waste in SB 14 reporting years. In addition, SB 14 requires the DTSC to select at least two categories of generators by Standard Industrial Classification (SIC) code every two years for evaluation. Subgroups of the chemical and allied products manufacturing industry were chosen as categories of generators for review of their 1995 source reduction documents prepared under SB 14. SIC codes represented within this report include 2819, 2834, 2836, 2841, 2843, 2869, 2879, and 2899 (see appendix A for a complete description of these SIC codes)

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I. BACKGROUND

The Hazardous Waste Source Reduction and Management Review Act of 1989 (SB 14) applies to businesses that routinely generated over 12,000 kilograms (13.2 tons) of hazardous waste, or 12 kilograms of extremely hazardous waste, in 1990, 1994 and in succeeding reporting years, which occur at four year intervals. Affected generators must prepare documents that demonstrate that they conducted a thoughtful effort (present and past) to identify, evaluate, and then implement feasible source reduction measures. Source reduction involves taking actions before waste is generated to reduce the quantities or hazardous characteristics of waste by addressing the sources that produce waste. Source reduction measures can be grouped into categories such as input changes - substituting hazardous substances for nonhazardous or less hazardous substances, process modifications - modifying production process variables or equipment, operational changes - improving housekeeping practices, production scheduling and maintenance practices, administrative changes - such as altering procurement practices, establishing specific policies and procedures to achieve waste reduction, and lastly product reformulation. Specific requirements for SB 14 can be found in Health and Safety Code Sections 25244.12 - 25244.24 and Title 22, California Code of Regulations sections 67100.1 - 67100.14.

The primary goal of requiring companies to review and incorporate source reduction practices is to promote public health and safety and to improve environmental quality. However, source reduction also can help businesses become more competitive and efficient. While source reduction measures typically reduce waste treatment, disposal, or recycling expenses, they may also have other cost savings/efficiency implications by preventing losses of raw materials, water and/or energy. The premise underlying SB 14 is that once companies thoughtfully consider source reduction alternatives they will implement source reduction measures because of their economic interest.

SB 14 documents reviewed for this report cover the period 1990 through 1998 with the most recent reporting year represented being 1994. The reviewed documents included 1995 Source Reduction Plans (Plan) covering the four year planning period 1995-1998 and Management Performance Reports retrospectively discussing the period 1990- 1994.

The future oriented Plan must include information about the facility's operations including production process overview descriptions and waste generation data for the most recent reporting year. Plans must also list potential source reduction alternatives for the significant sources which produce major (above five percent by weight) routinely generated waste streams. Discussing specific criteria such as economics, waste reduction potential, technical considerations, air, water, or land impacts, and health and safety implications for each potentially feasible source reduction alternative, the Plan explains the rationale for determining why measures are considered either feasible or infeasible. For feasible options, the Plan includes a schedule for implementing measures, and expresses a source reduction goal (percent) that serves as a target that could be reached over the four year period under optimal conditions. Plans, and Reports (see below) also must include certification statements signed by responsible parties which demonstrate management awareness of, and financial commitment towards implementing the Plan.

The retrospective Management Performance Report (Report) discusses waste management (waste stream disposition) for the reporting year and also describes past experience with source reduction measures, changes in waste management methods, production, and other factors that have affected routine waste streams generation since the reporting year used in the previous Report.

A third document, the Progress Report, is the completed form GM s which are contained in the US EPA (biennial) Hazardous Waste Reports. Many of the companies subject to SB 14 are also subject to the reporting requirements of the Hazardous Waste Report; therefore, these companies have already completed the form GMs. These forms were intended to track major routine waste generation normalized to account for changes in production throughput. AB 1089 eliminated this Progress Report. AB 1089 does however, replace the biennial progress report with a four year progress update which is to be submitted to DTSC.

SB 14 requires DTSC to select two categories of generators by Standard Industrial Classification (SIC) code every two years for source reduction planning assessment. As part of this assessment, request letters are sent to specific groups of generators (see appendix B) to obtain documents for either technical or completeness reviews. Generators that submit noncompliant or incomplete documents are required to revise their documents. Staff also conduct site visits, and research existing industry literature. Technical reviews of similar companies culminate in assessment reports such as this one, factsheets, or case studies all directed to assist and motivate companies in identifying potential source reduction practices that may be applicable to their processes and waste streams and to demonstrate that source reduction has economic and well as environmental benefits.

DTSC selected the Chemicals and Allied products industry for source reduction planning assessment during fiscal years 1996/97 and 1997/98. This report excludes petroleum and polymer/resin, and paint manufacturing firms (see previous reports 521,533, and 535) includes companies classified under seven different SIC codes in the 2800-2899 series. Specific codes represented include 2819, 2834, 2836, 2841, 2843, 2869, 2879 and 2899 (see appendix B for definitions of these codes). An initial list of companies was assembled using data from the DTSC s manifest tracking system. Data from the U.S. EPA 1995 Hazardous Waste) Reports, and the Emergency Planning and Community Right-to-Know Act (EPCRA) Toxic Release Inventory helped further refine the list. Forty (40) companies were selected for review. These companies were selected to obtain [for this report] a sample of companies based upon their waste manifest quantity for the SB 14 reporting year, easily identifiable business classification, and company reputation as industry leaders. Other companies under the above listed SIC codes will be requested to submit SB 14 documents for reviews subsequent to the issuance of this report.

II. Introduction

This report reflects the results of examining source reduction planning documents prepared by California facilities in the diverse Chemicals and Allied Products industry (excluding polymers, paints and coatings, and petroleum refining). Tables one and two, which separate chemical manufacturers and reprocessors from pharmaceutical and biotechnology facilities, provides a complete list of reviewed companies along with their SIC codes and primary products. Typical products produced by these firms include catalysts, specialty coatings, detergents/surfactants, high purity chemicals, agricultural chemical products, and pharmaceuticals or biological products used as medicines for treating human/animal diseases, genetic deficiencies and/or infections. Because of the unique nature of biotechnical and pharmaceutical products and Food and Drug Administration oversight of any modifications affecting these products, such as changes in processes and product raw materials, these companies are treated as a separate group in this report. The remaining companies are referred to as chemical manufacturers.

Chemical Manufacturing and Processing Companies

The chemical companies discussed in this report manufacture intermediate or end use chemical products by using primary chemicals or spent chemical solutions as base materials. Although the products and waste streams produced by chemical firms are diverse, many of the production processes conducted by these firms are similar, i.e., production involves initiating chemical reactions with the aide of catalysts, heat, vacuum and pressure which produce process mixtures. Typically additives are then incorporated. Process streams are refined, and then modified to a final form for packaging and distribution. In some instances, the byproducts generated from chemical reactions can themselves be refined to produce commercially viable products. In chemical reprocessing operations, chemical substances of interest are often separated by distillation processes. The many possible variations in process, process parameters, and raw material input combinations make it possible for some chemical firms to make hundreds of specific products; others firms specialize in just a few products.

Chemical manufacturing source reduction opportunities were identified in the following areas: process optimization (maximizing product yields), in-process reuse of process stream byproducts including wastewater, mother liquors, and onsite chemical recovery, improved batch production scheduling, bulk chemical procurement and in-plant delivery systems, improved hazardous and non hazardous waste segregation, dedicating production equipment to particular products, reducing inventory losses and excess chemical waste through bar code labeling and computerized tracking, preventing leaks and spills through upgrading valves, seals, piping, and material conveying and metering equipment, improving cleaning operation efficiencies and methods, and expanding efforts to find non hazardous or less hazardous substances for cleaning equipment and plant infrastructure. Product reformulation is also an area with potential to reduce hazardous waste generation. Unfortunately this category of source reduction opportunity was not considered by most of the firms reviewed for this report.

TABLE ONE

<i>CHEMICAL MANUFACTURING AND REPROCESSING COMPANIES</i>					
Name	SIC Code	Federal Reporting	Documents prepared by:	Primary Product(s)	1994 routine waste quantity reported-- Tons
Air Products and Chemicals	2899	96TRI, 95HWR	Facility	Coatings Polymers	228
Allied Signal	2869	96TRI, 95HWR	Facility	foam blowing agents and hydrochloric acid	538
Amvac Chemical	2879	96TRI, 95HRW	Facility	Pesticides	26,722 (ww)
Bio-Rad Labs.	2869	95HWR	Consultant	Reagents, buffers, gels, ion exchange resins	255
Catalytica Bayview	2869	96TRI, 95HWR	Facility	Bulk Pharmaceuticals	1,317 (ww)
Chemron Corp.	2841	96TRI, 95HWR	Facility	Surfactants	66
Chevron Chemical	2879	96TRI, 95HWR	Facility	Pesticides & Gasoline additives	40,365 (ww)
Criterion Catalyst-Pittsburg	2819	96TRI, 95HWR	Consultant	Catalysts	488
Criterion Catalyst-Azusa	2819	96TRI, 95HWR	Facility	Catalysts	125,052 (ww)
Dexter Hysol Aerospace	2891	95HWR	Facility	Coatings, adhesives	143
Dow Chemical	28792-89928-21	96TRI, 95HWR	Facility	Ag.Chemicals Latex, purified water	10080
Dupont de Nemours	2819	96TRI, 95HWR	Facility	Titanium dioxide pigments	28259
General Chemical	2819	96TRI, 95HWR	Facility	Sulfuric acid	183
GNB	2819	96TRI, 95HWR	Consultant	Lead-acid battery recycling	57
Henkel -Emery Group	2899	95HWR	Facility	Oleochemicals, fatty acids	144
Kelco	2869	96TRI, 95HWR	Consultant	Algin and xanthan gums	37

Monsanto	2819	96TRI, 95HWR	Facility	Refining catalyst	32
Morton Electronic Materials	2899		Facility	Sulfuric acid	137
Nalco Chemical	2899	96TRI, 95HWR	Facility	Boiler and water treatment chemicals	1682
North American Chemical	2819	96TRI, 95HWR	Facility	Inorganic chemicals	1114
Perkins-Elmer	2836 3826		Facility	Phosphoramidites, assembled analytical instruments	180
Proctor & Gamble	28691	96TRI, 95HWR	Facility	Oleochemicals, fatty acids	503
Rodia	2819	96TRI, 95HWR	Facility	Sulfuric Acid, Oleum	429
Schmacher of APC	2869	96TRI, 95HWR	Facility	Purified chemicals	42
Star Pacific	2841		Consultant	Detergents	94
Stepan Chemical	2843	96TRI, 95HWR	Facility	Surfactants	75
Teledyne Ryan Aeronautical	2892 3489	-, -	Facility	explosive/pyrotechnic systems	23
US Borax	2819	95HWR	Consultant	Borax-based surfactants, fertilizers	88
Zeneca	2879 8731	96TRI, 95HWR	Consultant	Ag. chemicals and R&D	111
(ww) - wastewater represented the greatest quantity waste stream 96TRI - Facility reported data to the 1996 Toxic Release Inventory system, 95HWR - Facility reported data for the 1995 US EPA (biennial) Hazardous Waste Report					

Pharmaceutical and Biotechnology Companies

Among pharmaceutical and biotechnical companies (SIC codes 2834 and 2836) product-specific production techniques and cleaning/maintenance protocols take years to develop and to receive federal Food and Drug Administration (FDA) approval. Changing strictly controlled procedures, production techniques, and substances typically requires supplemental FDA approval. Depending upon the nature of the change some supplemental approvals can take years to obtain and may require a substantial investment. This barrier can add significant time to the planning horizon for incorporating source reduction practices. Some of the greatest source reduction opportunities may exist in the development of new products because most of these firms devote significant resources to research and develop new chemical compounds, drugs, or biological products.

A majority of these firms generate solvent waste, wastewater with organics, and corrosive wastewater from solvent-based chemical synthesis processes, from using liquid High Pressure Liquid Chromatography (HPLC) instruments to isolate, extract and/or experiment with chemical compounds, and from regenerating the resins in deionization units which are used to condition process water. The near term source reduction opportunities that appear to be most promising include continued emphasis on increasing titers (product yield), using reverse osmosis technology to purify water and extend the intervals between ion exchange resin regenerations, excess chemical give away programs, some chemical substitution in cleaning applications, and using sealless pumps and onsite filtration of hydraulic oils to reduce oil waste and extend lubricant change intervals.

TABLE TWO

<i>PHARMACEUTICAL AND BIO-TECHNOLOGY COMPANIES</i>					
Name	SIC Code	Federal Reporting	Documents prepared by:	Primary Product(s)	1994 routine waste quantity reported-Tons
3M Pharmaceuticals	2834	96TRI, 95HWR	Facility	Solid dose, Aerosol based, and transdermal pharmaceuticals	403
Alpha Therapeutic	2836	96TRI, 95HWR	Facility	Plasma Products	253,277 (ww)
Alza	2834	96TRI, 95HWR	Facility	Controlled release pharmaceuticals	678
Amgen	2836	96TRI	Facility	human biopharmaceuticals	327 (1993')
Bachem	2834	96TRI, 95HWR	Facility	Peptides	211
Chiron	2836	96TRI, 95HWR	Consultant	disease treating drugs and diagnostic kits	54
Genetech	2834	96TRI, 95HWR	Facility	Protien-based medicinals	21,663 (ww)
Lonza, Inc.	2834	96TRI, 95HWR	Facility	Pharmaceuticals	4,860 (ww)
MD Pharmaceuticals	2834	96TRI, 95HWR	Consultant	Pharmaceuticals	118

<i>PHARMACEUTICAL AND BIO-TECHNOLOGY COMPANIES</i>					
Pharmavite Corp.	2834	96TRI, 95HWR	Facility	Vitamins	251
Roche Bioscience	2834	-, -	Facility	Pharmaceuticals	512
(ww) - wastewater represented the greatest quantity waste stream 96TRI - Facility reported data to the 1996 Toxic Release Inventory system, 95HWR - Facility reported data for the 1995 US EPA (biennial) Hazardous Waste Report					

III. SB 14 Compliance Problems

The reviews conducted for this report indicated that many chemical manufacturing and pharmaceutical/biological facilities were noncompliant with SB 14. Language in the documents and follow up with many of these firms revealed that there are misunderstandings about the purpose of the law and its requirements, and that SB 14 concepts and definitions were often misunderstood. These problems were aggravated when firms hired consultants to prepare SB 14 documents which minimally involved facility personnel in identifying potential source reduction opportunities. A number of firms did not recognize SB 14 as a way to document facility efficiency improvements, and also failed to adequately and clearly present the information which can serve as a basis for accepting or rejecting source reduction alternatives.

Seventy three percent of the firms reviewed for this report were required to revise and resubmit their SB 14 documents due to inadequacies in the way the documents were prepared. The problems ranged from administrative oversights, such as not including technical certification statements, to more serious problems such as using decision making matrixes as a source reduction measure evaluation without adequate supporting narrative to discuss the basis for the numbers generated in the matrix, and not explaining how the scores were used to make decisions. Table Three (page 9) shows the range of problems that were discovered and the degree to which these problems existed (shown as percentages). *The most serious problems were lack of identifying specific source reduction measures and lack of discussion regarding the criteria used to evaluate source reduction measures.*

Inadequate narrative and information specific to evaluative review criteria erodes confidence that a Plan's chosen source reduction measures will be implemented; this situation suggests that the evaluation process has not been completed. For example, many of the companies reviewed for this report listed unknown the determinations regarding economics, and many listed statements such as under consideration, further study required for other important evaluative criteria, etc., yet they also listed these measures in the implementation schedule. If an evaluator cannot provide an estimate of economic costs and benefits associated with a source reduction measure, it suggests that inadequate information exists by which to make a decision to allocate resources to implement the measure. One problem which illustrates the outcome of incomplete evaluation is failure to update documents to indicate source reduction measure implementation status. When DTSC requested the chemicals and allied products company documents for review, many documents had not been kept up-to-date. Many Plans listed dates (previous to the call-in and review period) for implementing or completing the study of measures listed in the 1995 Plan which had passed, yet it was not clear if the measures had been implemented. In a number of cases, follow-up investigation revealed that the measures had not been implemented. However, the documents contained signed certification statements indicating knowledge of, and financial commitment to, implementing measures chosen in the Plan. The underlying problem may be that company management lacks commitment to devoting the necessary resources to evaluate source reduction options. This is distressing given that many of the firms reviewed for this report state that they have source reduction or waste minimization policies in place.

Specific to chemical manufacturers, many of the firms covered in this report are members of the Chemical Manufacturers Association (CMA). CMA is a national group, which among other activities,

promotes and requires member firms to adhere to management codes specified in its Responsible Care program. Of most significance to SB 14 is the CMA Responsible Care code which states that *member companies will evaluate reducing waste and emissions at the source [source reduction] first before considering recycling or treatment options* . If industry developed programs such as Responsible Care are to have credibility among regulatory agencies and the public, then many of the firms covered in this report must prepare future SB 14 documents in a more complete and professional manner. Companies should regard SB 14 work as an opportunity to document feasibility assessments, rather than simply view it as a required report.

TABLE 3 - CHEMICAL & ALLIED PRODUCTS COMPANY SB 14 DOCUMENTS PREPARATION ERRORS, T=40

Percent of companies	SOURCE REDUCTION PLAN ERRORS
73 percent	Notice of deficiency issued to facility
60 percent	Incomplete/inadequate discussion of evaluative criteria for specific source reduction measures
58 percent	No technical certification in either the Plan or the Management Performance Report
47 percent	Incomplete or missing production process overview description
40 percent	Listed some non source reduction measures as source reduction measures
35 percent	Provided nonspecific in source reduction measure descriptions
33 percent	Diagrams did not show inputs and waste outputs for process steps
33 percent	No four year source reduction goal provided
30 percent	Did not address some categories of source reduction
30 percent	Diagrams did not show individual process steps
28 percent	Did not show, or incorrectly calculated waste stream percentages of total routine wastes
25 percent	For most or all potential reduction opportunities did not show quantities or figures for estimated waste reduction or economic costs and savings
25 percent	No financial certification in either the Plan or the Management Performance Report
23 percent	Discuss need to study, investigate or consider source reduction measure(s) further- unclear as to progress or remaining work needed to be completed
23 percent	Listed source reduction measures already implemented
20 percent	No timetable/schedule provided for planned implementation of chosen source reduction measures

**TABLE 3 - CHEMICAL & ALLIED PRODUCTS COMPANY SB 14 DOCUMENTS
PREPARATION ERRORS, T=40**

18 percent	Clearly misunderstood the distinctions among source reduction categories
18 percent	Included inappropriate listings as source reduction measures, such as decrease. production etc.
18 percent	Included residuals from waste treatment as source generated waste generation data
18 percent	Did not associate source reduction measures with specific waste streams or waste types
18 percent	Matrix presented as evaluation of measures, did not explain how numbers/scores were used
18 percent	Matrix presented as evaluation of measures, no supporting narrative provided
13 percent	Did not label, by California Waste Code, all or some waste streams
13 percent	Did not list California Waste Codes shown in DTSC' s manifest tracking database
13 percent	Implementation schedule was not specific as to what would be done when
13 percent	Relationship between the goal and the chosen source reduction measures was unclear
10 percent	Used multiple waste code labels to classify waste streams
10 percent	Several goals provided but not combined into one goal
10 percent	Included air emissions data or nonhazardous solid waste data in hazardous. waste generation calculations
10 percent	Included excluded waste types in waste generation data calculations
10 percent	Did not prepare new documents in 1995
10 percent	Incomplete facility description
8 percent	Certifications not labeled, incorrectly labeled, not signed, or no titles listed for signers
8 percent	Did not identify major, or did not adequately describe waste streams
8 percent	Did not show 1994 waste generation data
5 percent	No block diagrams provided
5 percent	Source reduction goal was not expressed as a percentage of routine waste
	MANAGEMENT PERFORMANCE REPORT ERRORS
28 percent	Incomplete discussion of factors affecting waste generation since previous baseline year
13 percent	None prepared as reflected in first submission of documents to DTSC

**TABLE 3 - CHEMICAL & ALLIED PRODUCTS COMPANY SB 14 DOCUMENTS
PREPARATION ERRORS, T=40**

10 percent	Incorrectly characterized waste stream disposition in reporting year
10 percent	Only listed or describes how some wastes are managed
5 percent	Did not discuss factors that have affected waste generation since previous baseline year
5 percent	Incomplete discussion of factors affecting waste stream management since prev. baseline yr.
5 percent	Did not show baseline year waste generation data
3 percent	Did not show reporting year waste generation data
3 percent	Did not discuss factors affecting waste stream management since previous baseline year
3 percent	Did not state reporting year
3 percent	Did not list or describe how routine waste streams are managed
3 percent	Claimed source reduction measure progress from non source reduction measures

Many of the compliance problems discovered in this review of the Chemicals and Allied Products industry are related to misperceptions and misunderstandings about SB 14 requirements. The discussion below is intended to clarify certain SB 14 requirements.

Source reduction alternative evaluation The statute and regulations which discuss source reduction measure evaluation require generators (CCR section 67100.5) to provide a Plan with sufficient detail to convey an understanding of the source reduction evaluation review and analysis performed. This section further states (67100.5(j) - (n)) that the evaluation should address the five categories of source reduction approaches, and at a minimum address seven evaluative criteria including economic cost and benefit, expected change in hazardous waste generated, technical feasibility, effects on product quality, employee health and safety implications, regulatory permit affected or required, and releases or discharges to other environmental media. The regulations and statute therefore intended that generators conduct a detailed analysis of potential (as opposed to possible) alternatives. One tool which can aide this effort, discussed in DTSC's May 1994 Hazardous Waste Source Reduction Guidance Manual, is a matrix which incorporates self-designed numerical scales. The matrix is a convenient tool for incorporating value judgements about how important specific evaluative criteria are, and about analytical results as a aide to decision making. Using economic criteria as an example, the matrix provides a way for a company to show how it views the importance of economic considerations as a evaluative criteria (weight). It also allows the company to rate the results of the economic analysis (rank). As an example, if the analysis of a particular source reduction measure's costs and benefits estimated that the payback period to recover the investment was three years (payback), one company might consider that good and give it a rank of four on a scale of one to five (least favorable to most favorable), another company might find that

payback period less acceptable and rate it as a two using the same scale. If both companies considered economic return as a significant factor in decision making and gave it a weight of four on the same scale, under economics, company one would give this measure a score of 16 (4X4), while company two would give it a score of only 8 (2X4).

The matrix was originally developed as a way of illustrating this information in a relatively simple fashion. This makes the matrix a good screening tool to use to narrow down the universe of possible options, and to show the rationale which served as the basis for rejecting certain source reduction measures. However, this matrix must be accompanied by narrative which discusses evaluative criteria for the Plan's chosen source reduction measures. The matrix should also include information which explains what the numbers mean and how scores were used. For the source reduction measures chosen by the facility, the evaluation documentation should discuss the important considerations and findings relevant to the evaluative criteria. Using the above example, the documentation for a chosen source reduction opportunity should discuss the economic costs and benefits of the source reduction measure and show the calculated payback period to recover initial costs.

In some instances, making a feasibility determination for any given source reduction alternative may take longer than the nine month period which extends from the end of the reporting year to September 1 of the following year. For these measures, the Plan may indicate further study needed; however, the evaluative discussion should indicate what information has been gathered, or other evaluative progress, and also indicate what additional steps or information is needed to complete the evaluation. The study plan can be shown on the implementation schedule.

While the law requires that a minimum of seven specific evaluative criteria be considered, it does not specify what other criteria might be used in evaluation. It also does not specify which criteria are most important and does not require that a facility improvement that reduces waste quantity or toxicity be considered primarily on the basis of how much waste will be reduced. Facility improvements which solve problems or reduce costs associated with needs for storage space, energy consumption, water use, air emissions, equipment maintenance expenses, risk of accidents and injuries, product yields, raw material costs, and product quality may also yield source reduction benefits. If so, these improvements can be characterized as source reduction measures and should be included in source reduction Plans.

Implementing source reduction measures SB 14 does not require facilities to implement source reduction measures. However it does require written documentation which reflects thoughtful consideration of potentially viable alternatives. Companies that research measures and determine them to be infeasible do not have to implement those infeasible measures; however, it is important to indicate [in the Plans] why a particular measure is deemed infeasible. As noted earlier, a matrix is a possible format for indicating the rationale for rejecting source reduction measures.

For source reduction measures where further study is needed to determine feasibility, the Plan implementation schedule should indicate when phases of study are anticipated to be completed. If feasibility study of a measure is anticipated to extend beyond the four year SB 14 planning period, then that should be indicated and discussed. For example, companies that make pharmaceutical or biological

products may need several years to complete a decision about changing processes, operations, or raw materials due to the need to conduct testing, analyze data and obtain FDA approval.

Many firms mistakenly believe that they must, in all cases, implement measures listed in the implementation schedule. Although generators should conduct an adequate investigation to support informed decision making about implementing source reduction measures, a Plan is a document which projects into the future. Unexpected occurrences or new information gathered after a Plan was initially developed may necessitate changing decisions about implementing measures or when to implement measures. To deal with these situations simply update the Plan document. DTSC recommends that, in addition to hard copy, facilities keep copies of SB 14 documents in an electronic form to facilitate updating and/or adding addendums to sections of the documents to keep information current. It was intended that SB 14 be a dynamic instrument that reflects current company decisions, goals, and objectives regarding a facility's source reduction program.

Waste stream determinations Several firms misunderstood the concept of source waste and the significance of auditing sources of waste. A number of firms incorrectly listed waste residuals from waste treatment as sources to evaluate for reduction opportunities. While waste treatment processes may be improved, or made more efficient, the wastes entering on-site treatment units or material recovery systems are already generated prior to entering these treatment or recovery systems. It is important to look at and understand where and why wastes are produced in the first place.

The source, or sources that contribute to the quantities of the wastes entering treatment/recovery systems, or the waste types which become major waste streams are the intended focus of the Plan's documentation of the source reduction opportunities review. In cases where several sources contribute to a waste stream, or waste code category, generators will have to decide which sources are significant enough to warrant a review of possible reduction opportunities. In order to make this determination, the best avenue for obtaining information typically is a waste audit in which quantities and/or characteristics of wastes are measured, or accurately estimated at each source that generates a particular waste. In some instances, affecting one source of waste via a process modification, operational change, or input substitution will affect the amount or hazardous characteristics of waste generated upstream of the first source. A common example for illustrating the above points is the waste (waste stream) collected in a sump which is often classified as CWC 223 - unspecified oil-containing waste. The sump is a handling system, it is not the source(s) that create the waste. Sources that contribute to this waste stream could be steam cleaning of facility equipment, spills from draining and refilling equipment oils or hydraulic fluids, or leaky seals on equipment containing internal lubricating equipment. Each source will have a different set of source reduction opportunities and each source may contribute a different quantity to the CWC 223 waste code type. In addition, at least two of these sources of waste are related. Replacing leaking seals on equipment may reduce the frequency of need to clean plant equipment which may be a significant source of this waste stream.

Major waste streams The distinctions among the terms waste code category, waste source, or waste constituents is confusing to some generators when they are determining which wastes are major waste streams, that is, above five percent by weight of total routine hazardous waste generated during the SB 14 reporting year. Almost one third of the companies reviewed for this report made mistakes in

determining which waste streams were major waste streams. The two most common reasons were failing to include aqueous hazardous wastes in quantities of routine waste, and including excluded waste types or waste residuals from waste treatment in waste data calculations.

The significance of proper determination of what are major waste stream is that the law stipulates that major waste streams must be reviewed for source reduction opportunities. There are several approaches to grouping wastes for the purpose of determining which waste streams are major waste streams; grouping by waste code category, by waste type constituents, or sources which generate the waste streams. In most instances, the choice among these three approaches is a generator judgement call. The 1994 Hazardous Waste Source Reduction Guidance Manual suggests that the most straight forward approach to determining major waste streams is to group waste quantities by waste code category. This is the recommended approach, and this approach should be used in cases where there are many small waste streams by source and no individual source generates, by weight, more than five percent of total routine wastes. However, the source reduction review is based on reviewing reduction opportunities which are specific to the sources which generate waste. Where individual sources generate more than five percent of routinely generated wastes, there is an option of determining which waste streams are major waste streams based on the sources which generate the waste. Another option is to group waste quantities by waste code and according to the similarities in the constituents which comprise the wastes. This approach might be particularly germane in cases where the wastes under the same waste code category are managed in the same manner. As noted earlier under the discussion of waste stream determinations, whichever approach is used to determine major waste streams, residuals/byproducts from waste treatment or recovery systems should not be included in waste generation quantities.

Plan and Management Performance Report°Certifications A surprising number of companies (58 percent) make mistakes certifying their SB 14 documents. Most of the errors involved not including technical certification statements in either the Plan or the Management Performance Report (Report). Some firms also used the language from the financial certification (the same for both documents, page 52 in the Guidance Manual) for the technical certification language. A few companies also did not sign the documents or did not include the title of the signatories. In addition, several firms included statements but did not label what the statements represented (the regulations do not require this, but it is recommended). While precise language for the technical certifications was not specified in the Guidance Manual, certification statements in each document should list and indicate that the requirements specified in the regulations have been addressed. Note appendix C which provides sample technical certifications for both the Plan and the Report.

Commentary on Compliance Problems

While the above discussion highlights some of the most common non compliance issues discovered in the Chemicals and Allied Products Industry, the range and depth of problems found in these documents was surprising. In response to these findings, DTSC staff spoke at northern and southern California meetings of the Chemical Industry Council of California to bring industry SB 14 compliance problems to light and to urge improvement. It was pointed out in these meetings that the current flexibility within SB 14 should not be taken for granted. It is likely that DTSC will review new and updated chemicals

and allied products SB 14 documents after the next iteration documents is due for completion (post September 1999). If non compliance problems continue the Department could consider making a marked change from past and current practice which is solely geared towards marketing source reduction based on its merits as a cost effective environmentally responsible business practice. It has been DTSC practice to (rather than fine noncompliant facilities) work with noncompliant facilities to bring them into compliance with as much flexibility as is possible under the law; even in cases where firms have not prepared these documents.

More importantly for the chemical and allied products industry, continued poor SB 14 compliance could mean that the industry's voluntary programs and associated desire for more regulatory flexibility, including management codes of conduct will be subject to increased scrutiny. For example, there may be calls for independent verification of the effectiveness of these programs. In addition, California's Certified Unified Program Agencies (CUPA) may take an enforcement approach in cases of SB 14 noncompliance. Assembly Bill 1089 of 1997 grants CUPAs authority to review SB 14 source reduction planning documents and to assess penalties for noncompliance. SB 14 noncompliant companies could also face problems in the areas of public perceptions regarding their commitments to environmental performance. For example, since 1995, a number of public interest groups have requested access to SB 14 documents using the provision in California Code of Regulations section 67100.3(b) which requires companies to make documents [upon request] available locally for public review. Some groups which have requested documents include Communities For a Better Environment, the Sierra Club, Peninsula Conservation Center Foundation, Planning and Conservation League, Silicon Valley Toxics Coalition, and the Madres del Este Los Angeles. Much of the information received by DTSC regarding these independent reviews has been critical on the quality of the documents.

To help avoid future compliance problems, SB 14 regulated facilities should at a minimum, carefully review the materials supplied by DTSC such as the source reduction planning Guidance Manual and also consult with DTSC program staff when questions arise about what to do and how to do it. Facilities that hire consultants to coordinate their SB 14 efforts and prepare the documents should encourage their consultants to contact DTSC for clarification of SB 14's requirements and to obtain information regarding source reduction practices in particular business or industry groups. Consultants should then encourage facilities to conduct waste audits and work with personnel to ensure direct company involvement in the SB 14 process to the greatest extent possible. Generators should also note that DTSC has resources that can help with the source reduction review process. Among others these resources include, industry source reduction planning assessment reports, such as this one, business-specific waste audit studies and checklists, and a technical library of collected articles, books, manuals and other publications searchable by keywords in publication abstracts that have been entered into a computerized database. DTSC also has relationships and contacts with national universities and laboratories which research cutting edge pollution prevention technologies, and with hundreds of local pollution prevention programs via its membership in the National Pollution Prevention Roundtable.

In summary, SB 14 compliance problems can be avoided. Overall, view SB 14 as an opportunity to access potential facility improvements which can reap savings in the bottom line, maintain or improve community relations, and help preserve and promote a responsible movement towards regulatory

flexibility. As can be seen in the next chapter, most companies have identified and implemented source reduction measures. Indeed, almost all have identified at least one implementable measure. The problem is that with compliance issues noted, it is impossible to determine whether most companies are aggressively pursuing source reduction or only showing minimal interest.

IV. Company Profiles

This chapter provides individual descriptions of the facilities whose SB 14 source reduction planning documents were reviewed for this report. Each profile provides company Standard Industrial Classification code(s) and location, and describes the primary products produced by the facility, the process(es) used to produce products, 1994 reporting year waste streams, source reduction measures planned or reviewed as a result of the 1995 source reduction Plan, and past source reduction experience based on the information provided in the 1995 Management Performance Reports. Document non compliance problems identified in this chapter have been discussed in the previous chapter in aggregate rather than for specific facilities. This report's company profiles do not discuss individual company SB 14 compliance problems. However, because of document deficiencies, information describing individual company products, processes, and wastestreams etc., in this chapter were derived or supplemented from followup discussions with facility environmental personnel, health and safety managers, process engineers, or facility managers.

3M Pharmaceuticals

SIC code 2834

Northridge

This facility formulates various types of solid dose pharmaceuticals such as analgesic-containing and anti-inflammatory medicines, aerosol-based products which contain chloroflourocarbons, and transdermal drug delivery (TDD) patches.

Process

To make solid dose products, active and inert ingredients are mixed in vessels with either alcohols or acids and then processed into tablets through a die press. To make aerosol products, batch ingredients are mixed in tanks and then packaged by automated refrigerated filling equipment which combines the aerosol propellants with the batch ingredients. TDD products are produced by coating rolling stock with the drugs nitroglycerin or estrogen, and an adhesive. Using automated machinery, the coated stock is cut in to single dose patches and each patch is inserted into protective pouches and packaged.

1994 Waste Stream Generation

Five major routine waste streams were generated in the reporting year. The largest by waste code category was CWC 311- pharmaceutical waste; 154 tons. This waste included off specification materials including coated roll stock cuttings from TDD production, batch tailings, expired raw materials in inventory and quality assurance samples. Off specification product is generated at the beginning and end of production runs because of process heat variations. In addition, until process temperatures stabilize quality assurance samples must be taken and these samples become waste. Packaging waste is generated due to inefficiencies in the automated packaging lines which generate reject aerosol cans. Aerosol waste classified as CWC 343 -unspecified organic liquid mixture; 143 tons,

CWC 212- oxygenated solvents, and CWC 211 - halogenated solvents includes excess condensed aerosols and Freon from the filling stations and aerosols or Freon containers from rejected lots of product. Freon still bottoms (CWC 211-halogenated solvents) were secondary wastes removed as residual from an onsite Freon recovery unit. Solvent waste, classified as CWC 213 -hydrocarbon solvents; 16.5 tons, is generated from cleaning adhesives from equipment, from tank clean outs, and maintenance activities associated with the solid dose and aerosol batch processing operations. The CWC 512- empty containers waste stream consists of fiber drums containing excess cutting material from the manufacture and packaging of transdermal patch products.

Source Reduction

To reduce Freon and aerosol container waste chosen strategies included revising quality control inspection procedures. This will help reduce disposal of whole batches of Freon packaged product when only some of the batch s containers fail quality standards. This will also include instituting better segregation of rejects enabling identification of problems causing rejected containers. In addition, to reduce waste generated from leaking containers, the facility planned to replace the aerosol can rubber gaskets that occasionally leaked with alternative gaskets made from a different type of rubber that is less likely to leak. Less Freon waste was also generated from this change because the site produced gaskets were soaked with Freon to remove plasticizer prior to their use. The Plan also listed improving production scheduling to prevent or reduce machinery downtime during employee breaks to minimize the problem of heat damaged product and improving the tracking of Freon purchasing by specific departments to cut inventory waste.

To reduce transdermal products production waste several measures were proposed. One was to synchronize automated lines by adjusting the line s computer controlled settings. Another was to use rolls with uncoated ends, or uncoated feeder rolls on the machinery during a TDD product changeover period as an alternative to shutting down lines to reload coated feeder rolls. Another proposal to reduce waste generated from equipment shut downs and start ups was to keep TDD production lines going during employee breaks by staggering breaks to maintain a continuous operation. Another proposal was to replace the two millimeter liners that are used to protect roll stock product (before the stock is cut into individual patches) with thicker liners since the thinner liners could not withstand the stress of the cutting process. Because of this problem, the two millimeter liners became waste when they were routinely removed (just before patches were cut) and replaced with a thicker liner. In 1998, the facility also plans to install a closed loop pressure vessel cleaning system with custom designed vessels and pumping stations with vapor recovery capability to reduce Freon air emissions. Although not source reduction, this system will also make it possible to collect and use batch tailings (Freon remaining in the bulk vessels used to fill the aerosol containers called the heel) and cleaning solvent, and then recycle this material off site instead of managing it by incineration

Past Source Reduction

The hexagonal patch liner for transdermal products was changed to an oval shape to eliminate liner

waste generated in the patch cutting process. The new design allowed the liner cover to be the same size as the patch without excess edges. This successful innovation involved purchasing new packaging machines, conducting a market study, and obtaining FDA approval, and had a \$350,000 cost. Savings since this measure was implemented in 1994 are estimated to be approximately 3.5 million dollars, and annual waste has been reduced by 29 tons.

Air Products and Chemicals

SIC code 2899

Vernon

This facility produces epoxy curing agents, also known as hardeners and other specialized polymer intermediate products which are used by customers to formulate coatings, paints, aerospace application composites, adhesives and electrical potting compounds. Six categories of epoxies are produced including aliphatic amines, polyamides, aromatic amines, amidoamines, cycloaliphatic amines, and tertiary amines. The facility annually produces as many as 150 products and uses over 250 different types of chemicals during typical production cycles.

Process

Batch by batch production begins when raw materials such as formaldehyde, solvents, resins, alcohols, amine blends, additives and catalysts are charged into reactor vessels. Ingredients are mixed with a variable speed agitator and reacted using precise temperatures and pressures. The operation is largely computer controlled with a TI-STAR[®] process control system. All reactors have a temperature control system which includes internal coils that circulate cooling tower water for heat removal, and external jackets that circulate either oil or steam to heat process mixtures. Reactor vessels contain overhead distillation columns with reflux condensers connected to cooling tower water to capture unreacted raw materials for in process reuse while overhead condensers collect excess water for removal. When reactions are complete, process mixtures are drained from the bottom of the reactors and pumped either through a filter media, to drumming stations, or to intermediate holding tanks for further processing.

1994 Waste Stream Generation

The two largest routine waste streams produced at the site were CWC 331- off specification, aged or surplus organics; 112 tons, and ketimine resin waste containing methyl isobutyl ketone CWC 272 - polymeric resin waste; 56 tons . Some of the CWC 331 waste was nonroutine because it was nonusable expired product received from other facility sites. The third largest routine waste generated at the facility was contaminated trash (CWC 352-other organic solids; 52 tons) which consisted of filter bags, rags, personal protective equipment, cleanup debris from spills and leaks, small containers containing sample waste and debris. Another waste stream generated at the site was waste oil.

Source Reduction

A TI-STAR process computer control system was implemented in 1994, before the Plan was written, to reduce off specification organic waste condensed from reaction vessel off vapors by up to 50 tons annually. To reduce methyl isobutyl ketone (MIBK) waste generated from making Amicure KT-22

ketimine resin, a coalescer unit was installed to collect MIBK byproduct for in process reuse and reduce cycle times to increase product yield. This process modification had an estimated cost of \$150,000 with a simple payback of less than 2 years. To reduce plant cleanup waste from leaks and spills the facility is continuing phased purchase and installation of seal-less coupled magnetic pumps. Larger filter bags will be used in 1997 to reduce filter waste by decreasing the need to change out filter bags. The facility's four year source reduction goal is 22.8 percent.

Past Source Reduction

Past measures discussed in the Management Performance Report included incorporating bulk raw material delivery systems for certain products, improving inventory control procedures, improved practices for charging raw materials, reverse addition of amido-amines in reaction processes, and installing seal-less pumps. Computerization (December 1993) has helped optimize process yields which has reduced off specification product and the frequency of taking quality control samples which generate waste. Waste generation at this facility significantly increased comparing reporting years 1990 with 1994 going from 117 tons to 677 tons. Significant increase in Ancamine K-54 production was described as the factor which created waste stream generation increases.

Allied Signal Chemicals

SIC code 2869

El Segundo

This facility manufactures dichlorofluoroethane and chlorodifluoroethane which are used as blowing agents for insulating foam. Hydrochloric acid (HCL) is also produced as a co-product and is sold as a raw material industrial feedstock. The site also packaged chlorofluorocarbons and hydrochlorofluorocarbons in cylinders, jugs, and drums. Some portion of these materials are blended with organic solvents or other organic liquids prior to being packaged. Between 1990 and 1994 the previous production of ammonium derivatives, sodium, and aluminum sulfates and sulfites was discontinued. Since 1996, this facility has not packaged chlorofluorocarbons.

Process

The production of dichlorofluoroethane and chlorodifluoroethane starts when anhydrous hydrogen fluoride (HF) and 1,1,1, trichloroethane (TCA) are heated and agitated in enclosed vessels to initiate chemical reactions that produce a crude liquid. This liquid is then routed to a phase separator. In the phase separator unreacted HF is collected and returned to the reactor. The crude then passes through a TCA recovery column. Liquid TCA is collected from the bottom of the column and returned to the reaction process. HCL is then separated from the crude via low temperature distillation. The crude is then vaporized and scrubbed to remove residual acids. After the initial scrubbing, the vapors pass through a reactor in which impurities are reacted with chlorine. The crude is then scrubbed again. This step is followed by a series of final purification steps which separate various grades of product.

1994 Waste Stream Generation

The site's largest waste stream was high boiler waste (CWC 792- liquids with $\text{pH} \leq 2$ with metals; 453 tons) which is impurities that are removed during daily purging of the process reactor vessels. The second major waste stream was molecular sieve and alumina (CWC 181 - other inorganic solid waste; 57 tons). This waste comprises spent process input substances used to remove moisture from the intermediate product. Waste paint/ paint containing [waste], either dried or solidified, or collected in the dust collection system after being removed from used metal cylinders via surface blasting was another routine waste type classified as either CWC 461-paint sludge, CWC 591-baghouse waste, or CWC 352-other organic solids; 4.7 tons).

Source Reduction

The one source reduction measure identified and studied for the site's largest waste stream was purchasing higher quality raw materials. This single option was rejected because it was considered economically infeasible. The Plan noted however, that the production technology used at the site was relatively new (since 1993) and that an internal team periodically reviews future opportunities to reduce high boiler waste through loss prevention, and improved scheduling and maintenance. A supplement submitted after the initial Plan was sent to DTSC stated that to reduce CWC 181, alumina would be replaced with molecular sieve. This input substitution was an improvement because molecular sieve lasts longer than the same amount of alumina. This extends the intervals between drying agent changeout events which generate waste. Follow up information from the plant manager indicated that molecular sieve waste was a hazardous waste because of its acidity in 1994. Recent process modifications have prevented this waste from becoming acidified and it is no longer classified or managed as a hazardous waste. Hazardous paint waste generated in the metal cylinder spray painting booth has been reduced by using paint that does not contain chromium, lead, or 1,1,1, TCA. A system is now in place to recover heel material remaining in product cylinders which are returned to the company for cleaning and reuse. The heel material is evacuated, condensed to a liquid, and tested. Material that meets product specifications is then stored for later use.

Past Source Reduction

The measures discussed in the facility's 1991 documents are not relevant to the current processes, operations, and waste streams produced at the site beginning in late 1993 onward because of the changes in process technology and products produced at the facility.

Alpha Therapeutic Corporation
Los Angeles

SIC code 2834/2836

Alpha Therapeutic produces plasma derived pharmaceutical products for human use. Specific trade name products produced by the firm include Venoglobulin, AlphaNine Alphanate, Albutein, and Plasmatein. The firm is developing new products in the therapeutic areas of hematology, hemostasis, and immunology.

Process

Frozen blood plasma received by the facility is first thawed and then washed with solvent to remove any potential viruses. The plasma is then suspended in solvent solution, or alcohol-water solution and proteins of specific interest are extracted from the plasma by thermal precipitation and by varying the solution pH. Purified water used in solutions is produced at the site using a combination of initial filtering, reverse osmosis, degasification, ion exchange, and the steam distillation followed by ozone treatment. Following the extraction process, proteins are then separated from the solvent solution by centrifugation and filtration. Once separated, the proteins (intermediate products) are chilled to subambient temperatures for storage and further processing. In the final processing steps, the product is put into glass viles and sterilized by one or more methods which may include autoclaving, nitrogen bath emersion, or pasteurization.

1994 Waste Stream Generation

The largest waste stream generated at the site was CWC 132 - aqueous solution with metals generated from steam cleaning and rinsing of process equipment, and from spent water treatment solution containing either ammonia and/or hydrochloric acid (248,000 tons). Rinsing and buffer cleaning solutions contain sodium bicarbonate, acetic acid or hydrochloric acid. Some portion of this waste also includes water flushed from the site boilers (blowdown). Other liquids wastes include waste ethanol (CWC 343 - unspecified organic liquid mixture; 3915 tons), spent acetone (CWC 212- oxygenated solvents; 1040 tons), and barium chloride (CWC 132 -aqueous solution with metals; 97 tons). These streams are generated as spent plasma washing solutions and spent protein extraction solutions. Oil waste containing solvents and or chemical refrigerants (CWC 221 - waste oil and mixed oil; 33 tons) is generated from compressor fluids changeouts.

Source Reduction

The company s source reduction Plan indicates that the facility will continue to improve its solvent dispensing operation. Improvement in this system began prior to 1994. The system relies on electromechanical components including vacuum pumps, micro flow meters, and volumetric control valves which automatically regulate solvent dispensing operations. The company s Plan also states that the firm s goal was to reduce industrial wastewater by five percent by the end of 1996.

Alza Corporation
Vacaville

SIC code 2834

Alza Corporation, which submitted a multi-site source reduction Plan and Management Performance Report, researches, develops, and manufactures controlled release drugs in the form of tablets, transdermal patches, electrotransport systems, and implantable therapeutic systems including small infusion metering pump systems used in animal research. Although Alza Corporation has other California facilities, the company's primary manufacturing operations are conducted at the Vacaville site, the focus of this profile/review.

Process

Raw materials including active drugs, excipients, and solvents are the predominant raw materials used to produce the pharmaceutical/drug products at the facility. To produce tablet products, dry substances are weighed according to formula, blended with liquid substances and lubricants and pressed into tablets using preset dies. Tablets are then sprayed with a coating solution containing solvents which serve as diluents and drying agents. For some transdermal (TTS) drugs, substances are dissolved into a compounded medium which is extruded through a film forming die. The extruded film and substrate is then laminated and cut to size for packaging. Other TTS products are produced using a solvent casting process.

1994 Waste Stream Generation

The primary waste code types generated at Alza's Vacaville facility in order of quantity included CWC 214-unspecified solvents (445 tons), CWC 311- pharmaceutical waste (62 tons), CWC 212- oxygenated solvents -oxygenated solvents (15 tons) and CWC 211-halogenated solvents (14 tons). Much of the solvent waste was condensed solvent vapors from the solvent based coating solutions containing cellulosic membranes that are used to coat oral osmotic tablets. Solvent waste is also generated from cleaning equipment used to make transdermal patches. Pharmaceutical wastes included nicotine and other residual drug products cleaned from production equipment, contaminated personnel protective equipment, off-specification product, scrap film, and excess laminate material. Other wastes included lab packs and empty containers.

Source Reduction°

Much of the discussion regarding the source reduction planning work for the 1995-1998 planning period involved continued implementation of measures identified in the 1991 source reduction plan. For example, Alza will continue expanding the use of the company's environmental management software for chemical inventory tracking by using the system for the site's laboratory operations. The site also implemented a program to segregate non-contaminated solid wastes such as tyvek suits, gloves and other

personal protective equipment from other wastes which were deemed hazardous. Alza also purchased a stainless steel pressure dispensing system to eliminate the need to purchase some bottled solvents to reduce container waste. Alza, in conjunction with work done at its other California sites which are oriented primarily towards research and development of new products, will continue work to evaluate the feasibility of changing solvent based tablet coating solutions to water based solutions.

Past Source Reduction

Measures that were implemented at the Vacaville site include using leftover coating solution as makeup material for subsequent coating solution batches, increasing the solids content in coatings solutions to reduce solvent waste, and using isopropanol to clean equipment used to produce tablets instead of 1,1,1, TCA. In addition, the company has made some progress in developing water based coatings to replace solvent based coatings for some products.

Amgen, Inc. Thousand Oaks

SIC code 2834

Amgen manufactures two trade name biopharmaceutical products for human use which include Epogen[®], a substance that stimulates and regulates red blood cell production, and Neupogen[®], a substance that stimulates the growth of neutrophils (infection-fighting white blood cells). Research and demonstration of new biopharmaceuticals is a major activity at the facility.

Process

No process description was provided in the Plan. Biopharmaceutical products are produced from feedstocks created by biotechnological processes which produce proteins. The first phase of the processes involve transferring DNA fragments containing a code for a specific protein to a host organism. The host organism is induced to grow and multiply to produce many copies of the protein via a fermentation process. Fermentation involves supplying critical nutrients to the cells under sterile conditions at controlled temperature and pH. The fermentation process typically begins in a flask or other small vessel and once the cells reach a desired concentration they are transferred to a larger vessel to produce bulk quantities. Typically, the mixtures are agitated and aerated to achieve optimal conditions.. Following fermentation, the protein containing cells are separated from the growth solution typically by centrifugation and/or filtration. Cell membranes may need to be broken open to release proteins by either physical or chemical means. The protein product is then purified through extensive filtration and chromatography.

1994 Waste Stream Generation

The facility generated five major waste streams. The largest was corrosive waste water (CWC 135 - unspecified aqueous solution; 310 tons) generated from cleaning vessels and the pipes connecting to the

cell culture fermentation. Other waste streams included waste solvents (CWC 214-unspecified solvents; 10 tons) such as acetonitrile and xylene generated from outdated inventory, and from lab operations such as synthesis of proteins using high performance liquid chromatography (HPLC) instruments. Other routine wastes included waste oil (CWC 221; 3 tons) generated from compressor and vacuum pump oil change outs, and used lab packs.

Source Reduction

No measures were chosen for implementation. The Plan lists no specific measures except for waste oil reduction via replacing oil lubricated pumps with non oil type pumps. No evaluative criteria were discussed for this measure nor was any specific information included. Researchers at the site apparently have been unwilling to investigate auxiliary equipment or alternative models of HPLC instruments which other firms have used to reduce waste.

Past Source Reduction

Although this measure may not fall within the definition of source reduction, a waste minimization measure implemented by Amgen in 1992 was to establish a program to divert useable retrograde chemical supplies (expired shelf life reagents) from the waste stream by donating them to educational institutions. Since 1992, approximately 10 tons of materials worth approximately \$300,000 have been diverted.

Amvac Chemical Los Angeles

SIC code 2879

This facility produces, formulates or packages liquid or solid granular pesticides primarily used in agricultural applications. Chemical intermediates are also manufactured at the site as well as plant growth regulators. Four departments listed in the Plan are subdivisions of the facility. The technical plant department produces pure materials for pesticides. The Liquid plant department does small scale formulating and packaging of end use products. The granular plant department produces products for slug and snail control. Pentachloronitrobenzene (PCNB) is a major facility product and is listed as the site's fourth department.

Process

Most of the products are produced in a batch process and operations include in-vessel chemical reactions and mixing in tanks. Additional process steps include purification and extraction, filtration, and packaging.

1994 Waste Stream Generation

The largest waste stream was CWC 134 - aqueous solution with total organic residues < 10 percent; 28,283 tons of wastewater that was filtered to remove solids. The majority of this waste was generated from product washing using a centrifuge and from venting emissions from the product which were

captured in caustic solutions within air pollution control scrubbers. Some of the wastewater was boiler blowdown water, cooling tower bleed off, and cooling water/condensate from reactor jacket draining; it was unclear if the water from these three sources was actually hazardous. CWC 343 - unspecified organic liquid mixture (352 tons) was a waste containing octane, HCB, and solvents that were generated when product impurities are extracted and condensed off a column within a crystallizer unit. CWC 135 - unspecified aqueous solution (155 tons) was generated from spent scrubber solutions, wet chemical residual from intermediate product drying, and from reactor vessel and tank clean out rinses.

Filter waste classified as CWC 181 - other inorganic solid waste (72 tons) was a another major waste stream. Most of this waste, which included spent bag filters, contaminated filter aid liquid state filter cake, was generated from production of meta sodium. Other waste generated at the site includes spent solvent solutions from cleaning and rinsing, and solids such as spent carbon used in air pollution control equipment and floorsweep which contains spilled product.

Source Reduction

To reduce CWC 343 - crystallizer impurities waste, a distillation column will be installed to more efficiently dry product (and thus control moisture content). This will reduce the concentration of unrefined product in the crystals waste and will also reduce the generation of CWC 135 aqueous waste. In combination with other planned improvements, these changes were estimated to cost \$1.2 million . A one year simple payback was expected with these investments due to anticipated increased product yields, and reduced waste disposal costs (PCNB and wet DMF). To reduce filter waste a filter press will be installed to remove excess liquid from spent filter bags for in-process recycle.

Past Source Reduction

To reduce CWC 135 aqueous waste generated from container and equipment rinse outs a countercurrent rising system was installed. To reduce CWC 343 crystallized waste, nozzles were installed in the extraction column to determine the optimum feed locations. To reduce CWC 181 filter waste a water softening system was installed. This system, which dropped waste generation from 110 lbs/batch to 20 lbs/batch, reduced the quantity of filter aid material needed and extended filter change out intervals. To reduce CWC 232 - pesticide wastes, the facility lists improved production scheduling, waste segregation, and tightened preventative maintenance as source reduction measures. In addition, filters were installed upstream of wastewater treatment unit carbon beds to extend carbon life. The facility is seeking an entity that can regenerate the spent carbon for reuse.

Bachem
Torrance

SIC code 2834

Bachem produces, through solid phase synthesis, peptides which are the active ingredients in some pharmaceutical products. Peptides are polymers of amino acids linked together by amide bonds. The

synthesis process involves reproducing the amino acid sequencing found in natural biological sources of peptides. The primary customers for peptides are pharmaceutical companies which buy them on a contracted basis. The bulk of peptide products are sold initially as investigational new drugs, and a relatively small number are sold as bulk generic drugs. In addition to manufacturing, research and development is a major activity at the facility. Bachem also produced derivatized amino acids that are building blocks necessary for peptide synthesis; however, this phase of production was discontinued in March 1996.

Process

Chains of amino acid derivatives are assembled using a proprietary polymer matrix and carrier solvents to couple derivatives in a desired sequence. The first step is to deblock molecule terminals in the resin to allow for eventual coupling of the peptide to the matrix. This is followed by a series of washing steps with different substances that shrink or swell the resin matrix material and remove residual material(s). Excess solution is removed in these steps via filtration. The amino acid is then coupled with the matrix through a reaction within an activation solution. The solution is then removed by filtration and the resin is washed in successive steps. The crude product is then cleaved from the polymer solvent matrix and extracted into a dilute aqueous acid. The peptide precursor is then purified via high pressure gas chromatographic techniques.

1994 Waste Stream Generation

The peptide purification process generates the largest waste stream CWC 133 - aqueous solution with total organic residues > 10% ;142 tons) which consists of 10-20% acetonitrile and 80-90% water. Solvent, which functions as a carrier, is removed through filtration in several of the production phases and is classified as CWC 214 - unspecified solvents ;31 tons), or CWC 211 - halogenated solvents ;35 tons).

Source Reduction

A primary source reduction measure planned for this facility was to establish a computerized inventory control system. The estimated cost of this measure was \$8,000. The simple payback period for this investment was estimated to be three to four years. In developing new products this company may use European based Fmoc (9-Fluorenylmethyloxycarbonyl) chemistry as an alternative to American based BOC (t-Butyloxycarbonyl) chemistry. Fmoc chemistry eliminates the use of halogenated solvents and some waste generation steps when compared to the BOC chemistry, although raw materials for Fmoc chemistry cost slightly more. Although not source reduction, a 60% drop in CWC 214 waste was anticipated in the future due to planned outsourcing. Two large capacity (2 kilogram) resin reactor vessels will reduce solvent cleaning wastes by decreasing the number of batches that have to be produced. The firm is currently conducting product specific research on how to maximize the amount of crude peptide introduced in the high pressure liquid chromatography instruments to achieve solvent waste reduction. Bachem is also conducting product specific research on non validated (FDA approved)

peptide products to increase the amount of peptide that can be cleaved given a set amount of gas and solvents in the gas reaction vessel. Success in this area will reduce flammable waste solvents generation.

Past Source Reduction.

Although specific information was lacking regarding the steps that were taken to reduce waste generation, the facility reports that comparing 1990 to 1994 the ratio of product yield to solvent use has increased by a factor of three. This improvement came as a result of more continuous production of peptide batches and from learning how to minimize solvent use through research and experimentation. Expanded production and refinement of purification techniques explain the reasons for increases in total routine waste generation comparing 1990 (83 tons) to 1994 (258 tons).

Bio Rad Laboratories Hercules

SIC code 2869

This facility batch manufactures life science research products including reagents, buffers, and gels (such as electrophoresis media) and ion exchange resins.

Process

This facility's batch production processes involves charging raw materials such as acids, organic solvents, monomers, deionized water and proprietary ingredients into vessels and reacting the substances under pressure at specific temperatures for particular durations depending on the substance being produced. Resins are produced via a suspension polymerization processes. Some products are washed in a filter column for purification or conversion. To purify products, solvent solutions are pumped through the columns to remove the unreacted materials and impurities. Acid solutions are used in the column to chemically convert certain products. Some converted products are washed with deionized water. Some products are dried by solvent rinsing. Bead-formed products are size sorted using wet screening rigs.

1994 Waste Stream Generation

The Plan listed two major routine waste streams generated from washing, purifying and drying processes; CWC 212- oxygenated solvents (88 tons) and CWC 214 - unspecified solvents (66 tons). Other waste streams included waste from sump cleanouts, reactor clean out waste, unreacted monomer solutions, residuals from pre-cast processes, off specification or expired chemicals, and off-specification product batches. Total manifested waste was 184 tons.

Source Reduction

The Plan lists 15 source reduction measures many of which are administrative and/or are described as needing additional study, and/or the measure(s) will not be fully implemented until the next SB 14

planning cycle which covers the period 1999 to 2003. The chosen measures listed included revising written procedures to specify the number of rinses and quantity of rinse solution used for vessel cleaning and to specify the flowrate used to dispense chemicals into the purification column. These measures were estimated to reduce waste generation by 1100 gallons (4.5 tons) per year annually saving \$4,000.

Examples of future source reduction measures to be implemented or studies completed included: using less solvent in the drying process (product specific), using less hazardous solvent (no specific alternative substances were proposed), and combining the water and solvent washes from some products for makeup solutions to use in subsequent batches. Other steps planned at this facility, that are not hazardous waste source reduction, but represent environmental improvements included recycling water in the bead sizing rigs by changing from a single pass through wash to recycle loop configuration, and conducting an administrative review and revision of operational procedures specifying flow and duration rates for solvent-water rinses used to size bead formed products. The first water conservation measure listed above was estimated to reduce water discharge from between 6-17 million gallons a year with annual savings up to \$362,000 in sewerage costs. The second water conservation measure listed above was expected to reduce annual water discharge by 1.8 million gallons.

Past Source Reduction

Past measures implemented at this facility included eliminating chloroform use and reducing methylene chloride use in equipment rinse cleaning operations, reducing inventory wastes by revising inventory management methods and procurement practices, increasing the batch sizes for some products to reduce equipment cleaning waste (solvent), and combining water wash and solvent wash steps into one water/solvent wash step to clean equipment when certain products are being produced.

Catalytica Bayview East Palo Alto

SIC code 2869

This facility produces specialty bulk intermediate chemical compounds that are sold to pharmaceutical companies, and one product that is sold to agricultural chemical companies.

Process

Catalytica produces bulk intermediate products by batch synthesis of organic raw materials. Raw materials are charged to a reactor, catalysts and solvents are added, and the process mixture is heated to initiate the chemical reactions. Depending upon the product, a reacted process mixture may be re-reacted one or more times in a series of reactor vessels to fully complete the initial synthesis process. Once the reactions are completed, process mixtures are cooled. During cooling, the organic compound crystallizes in the solvent solution forming a slurry. The material is then separated from the solvent using a centrifuge. This separated material, a wet cake, is then dried in a vacuum tumble dryer. The final product, usually a powdered solid, is then packaged.

1994 Waste Stream Generation

The largest quantity waste stream was aqueous wastewater containing various trace solvents (CWC 232 - pesticides and other waste associated with pesticide production; 1200 tons). The sources of this waste included unusable process liquids separated from process mixtures via phase separation, equipment cleaning rinses, and floor cleaning rinses which included storm water collected from the plant's tank farm area. The second largest waste stream was waste (salt) filtercake (CWC 181- other inorganic solid waste; 45 tons) generated from filtering the crystallized product separated from the solvent (slurry) solution. Solvent waste (CWC 214/252/343; 11.7 tons) was generated from the centrifuge process, dryer and vent condensate, and equipment cleaning solutions. Six tons of CWC 343 - unspecified organic liquid mixture were generated from the phase separation process in the production of the agricultural chemical compound.

Source Reduction

The Plan lists items such as employee training, waste segregation and chemical substitution. These items are all discussed in general terms. The Plan mentions that rain water run off is tested for hazardous constituents, and in cases where it is non hazardous, it is kept segregated from hazardous wastewater. Discussions with the environmental manager revealed that Catalytica has made progress in reducing solvent wastes and production costs by redesigning the manufacturing process for a product called 6-chlorooxindole (6CO). This change involved using a proprietary catalyst to reduce the number of processing steps needed to produce the product. The manufacturing process was also modified to reduce the number of product washes which resulted in reduced generation of aqueous waste.

Chemron Paso Robles

SIC code 2841

Chemron manufactures chemical surfactant products that are typically used in shampoo concentrates, body cleansers, and dishwashing soaps. Some product categories include amides, chembetaines, and sulfates. This site also manufactures specialty and intermediate products including phosphorous esters or ammonium compounds.

Process

Materials such as oils, water, sulfates, solvents, amidoamines, or amides are pumped to vessels through pipelines and hoses for blending or chemical reaction. Batch reacted or blended products are then strained in basket or bag filters.

1994 Waste Stream Generation

All waste generated at this facility was classified as CWC 352 - other organic solids; 65 tons, but this

figure did not include raw wastewater influent into the treatment system, only the residual sludge. Waste is generated from cleaning reactors or blending/mix vessels and the associated raw materials and final product transfer lines. Another source of waste was filtrate which includes spent filter bags. Ammonium compound and phosphorous ester products produced in reactor vessels are filtered to remove fine particulates. Surfactant products are also filtered for contaminant removal. Cleaning solution wastewater and off specification liquid product is distilled for water recovery and the water is reused in cleaning solutions. Sludge (bottoms) from the water distillation unit were disposed offsite. Off specification product and used oil were additional waste streams generated at the site.

Cleaning the tanks, vessels and lines used in conjunction with producing detergent-based products typically starts with an initial hot water-solvent rinse. This water was collected for use in the next batch of compatible product. The first rinse generated from vessel cleaning is followed by cleaning with a solution of D-limonene \square , (a citrus based aqueous cleaning solvent) and water which is heated to condense and then reflux the solution on the vessel walls. Spent cleaning solutions and rinse waters are routed to the water treatment unit.

Source Reduction

To reduce off specification phosphorous based product and wastewater generated from cleaning phosphorus pentoxide residual from reactor vessel walls, the facility tested the phosphorus pentoxide raw material it received from five different suppliers. It now buys this substance from the two suppliers which consistently provide a higher quality raw material. The Plan also mentions that the facility was investigating the feasibility of replacing phosphorus pentoxide with liquid polyphosphoric acid; this replacement was deemed infeasible for technical reasons (11-97).

This waste was also reduced through a process modification that improved the dilution of stearate (salt or ester from fatty acid) in the phosphorus esters production process thereby reducing particulates. This modification involved replacing a 1000 gallon vessel containing an axial flow mixer with a 3000 gallon vessel that contains a radial flow turbine mixer. This capital improvement, planned for implementation in late 1996, cost approximately \$65,000 and had a 12-15 year estimated payback. However, this change was not made because of source reduction benefit. It was made because existing equipment was aging and had inadequate capacity. This change was expected to reduce the CWC 352 - other organic solids by 7.5 %. To help minimize cleaning solution waste and waste product, the lines which transfer final products to packaging operations, are first purged using air pressure. In addition, the use of portable scales was instituted to load some products into drums directly from the reactors instead of using transfer lines. This change was estimated to cost \$7,000 with a 1-2 year payback. To reduce used filter waste, bag filters used to filter some detergent products are washed and reused. The Plan also noted that reusable stainless steel filters were being investigated as a possible substitute for disposable bag filters. D-limonene \square citrus degreaser has replaced a cellosolve-based cleaner for final cleaning of reactor and mixing vessels. To reduce expired product inventory, the facility implemented a batch numbering

system to backtrack off-specification materials to try and determine what caused the product deviation from specification. Tracking of expired product has also been initiated to see if the material can be sold or reworked before it is managed as waste.

Past Source Reduction

The scheduling of past waste reduction efforts is unclear. Previous efforts included increasing batch sizes to reduce cleaning related waste, cleaning rags to enable their reuse, and creating a lower grade product that used excess process water and cleaning solution waste as raw material. Although waste generation quantity increased comparing 1990 to 1994, when normalized to account for a 238 % increase in facility production, it appears that waste generation rates per quantity of product decreased.

Chevron Richmond

SIC codes 2899 and 2879

When the SB 14 documents were prepared in 1995 this facility produced an agricultural chemical, ORTHENE[®] (a bulk intermediate product), and techron (an additive used in Chevron gasoline). Production of both products has been discontinued in 1997, an incinerator used at the facility to manage waste streams has also been shut down, and the primary existing activities include only blending and storing materials.

Process

ORTHENE[®] is produced in a series of chemical reactions involving raw material synthesis, following by additional purification and processing steps such as cooling, washing, mixing and drying. Gasoline additives are produced in a series of steps, either batch or continuous which include several mixing stages, vessel enclosed chemical reactions, phase separation and distillation column stripping.

1994 Waste Stream Generation

The largest waste stream produced at the facility was generated from the production of ORTHENE[®] (CWC 741 - liquids with halogenated organic compounds ≥ 1000 Mg/L; 25,134 tons). Solvents are used azotropically as carriers in production of this product which is extracted from process mixtures leaving left over aqueous wastes which contain solvents such as methylene chloride, water, and unreacted or partially reacted trace chemicals. The largest source of this waste was the washing process. The other two waste streams designated as major included T-1815 aqueous wastes (multiple waste codes; 7,354 tons) and gas additive process (OGA) aqueous waste (CWC 135 - unspecified aqueous solution; 6,715 tons). T-1815 aqueous waste was generated from a variety of sources including polychemical plant sumps, laboratories, rainwater, and various processes conducted in the pilot chemical plant at the site. OGA aqueous waste was generated from phase separation and washing operations and consisted primarily of water and small quantities of unreacted raw material substances.

Source Reduction

Chosen source reduction measures at the facility included the following: for OGA wastes, increase recovery of water containing a raw material for in-process reuse in batch manufacturing process; specifics not described, but steps were expected to reduce this waste stream by 2050 tons annually. The other selected measures included reducing rainwater and other sources of water which contribute to the T-1815 aqueous wastes.

Past Source Reduction

The most significant measure instituted at the facility involved instituting an innovative proprietary metallurgical process in 1992 which made possible the in-process recovery and reuse of a raw material used in fuel additive production; a measure which produced annual savings of 2-3 million dollars and reduced OGA waste by approximately 168,000 gallons annually. In 1991 the OGA batch process was modified to switch from crosscurrent to counter current batch washing thus enabling use of the second wash water from one batch as the first wash water of the following batch; estimated reduction 226,000 gallons annually. In 1991 process batch size was increased reducing water and raw materials use; estimated reduction 30,000 gallons annually. To reduce T-185 aqueous wastes a flow restrictor was installed in the laboratory s waste sink to reduce aqueous waste generated from cleaning glassware; 2500 gallons reduced annually. To reduce ORTHENE[®] aqueous waste carbon steel solvent storage tanks were replaced with stainless steel tanks. This eliminated the need to use aqua ammonia for pH control and reduced waste generation by 50,000 gallons annually. Other measures included upgrading metering equipment to charge precise amounts of reactants into the reactor, with estimated reduction of 115,000 gallons of aqueous waste annually; also, using water instead of hydrochloric acid to wash an intermediate eliminated aqueous salt solution waste with estimated reduction of 555,000 gallons of wastewater. Combined, all of these approaches reduced Chevron s total aqueous waste generation by more than 1,146,000 gallons annually.

Chiron Corporation Emeryville

SIC code 2834

Chiron s Emeryville faciltiy manufactures the therapeutic drugs Betaseron[®] and Proleukin[®]. These are genetically modified versions of the natural human proteins beta-interferon and interleukin-2 and are used to treat multiple sclerosis and cancer respectively. Simple protein products usually referred to as antigens are also made by Chiron. In addition to drug products, the facility also makes a number of simple protein products known as antigens for use in several vaccines or diagnostic products. The facility makes two types of diagnostic test kits (RIBA[®] and Quantiplex[®]) which are for various human diseases including HIV and hepatitis B, and Hepatitis C. In additon to manufacturing, a significant portion of the facility is dedicated to exploratory research and development of new products.

Process

Biopharmaceutical products are generally produced by biotechnological processes which produce

proteins. The first phase of the processes typically involves transferring DNA fragments containing a genetic code for a specific protein to a host organism. The host organism is induced to grow and replicate the protein producing many identical copies via a fermentation process. Fermentation involves supplying critical nutrients to the cells of the host organism under sterile conditions at controlled temperature and pH. The fermentation process typically begins in a flask or other small vessel, and once the cells reach a desired concentration they are transferred to a larger vessel to produce bulk quantities. Typically, the mixtures are agitated and aerated to achieve optimal conditions.. Following fermentation, the proteins containing cells are separated from the growth medium typically by centrifugation and/or filtration. Cell membranes may need to be broken open to release the proteins by either physical or chemical means. The protein product is then purified through extensive filtration and chromatography.

1994 Waste Stream Generation

Two major aqueous wastewater streams (CWC122 - alkaline solution without metals; 1675 tons, CWC 791 - liquids with $\text{pH} \leq 2$; 837 tons) and four major non wastewater waste streams were generated in the reporting year. The sources for both aqueous wastes were spent fermentation vessel cleaning solutions, and acid or caustic wastewater flushed from the site s ion exchange water demineralization system after resin regeneration events. Non wastewater major waste streams included solvents (CWC 214 - unspecified solvents; 19.8 tons) generated from the chemical synthesis processes and from liquid chromatography, laboratory waste (CWC 551 - laboratory waste chemicals; 16.2 tons), generated primarily from empty glass chemical containers (CWC 513; 7.4 tons), and waste oil (CWC 221- waste oil and mixed oil; 3.5 tons) generated from change outs of lubricants from chemical, vacuum, and hydraulic pumps.

Source Reduction

To reduce chemical inventory waste the facility implemented, and is continuously improving, a chemical inventory tracking system that uses bar coding technology. This system was implemented at a cost of \$350,000. Although the actual waste quantity reduced is small, the primary benefit will be to provide an accurate dynamic inventory of the amounts and locations of all chemicals in the company, thereby substantially reducing duplicative and unnecessary chemical purchase orders, and significantly reducing the annual costs associated with conducting a chemical inventory. This system also tracks hazardous wastes generated at the facility. To reduce chemical reagent glass bottle container waste, the company is now using high density polyethylene containers that contain removable teflon liners. These containers, which range from 10 to 200 liters, are used in nine of the site s laboratories. When the containers become empty they are returned to the vendor for refilling. The facility also plans to investigate using pumps and vacuum systems that do not use oil as an internal lubricant. In a new research and development building to be occupied in mid 1998, there will be a pharmacy-style chemical distribution system established. Chemicals used in the building will be stored in a central pharmacy area and ordered by departments or laboratories when needed. This will reduce the accumulation of chemicals in the laboratory, the occurrences of expired chemicals, and the ordering of separate quantities of chemicals for each laboratory or department.

Past Source Reduction

To reduce wastewater from resin regenerations, a reverse osmosis water treatment system was installed in August 1995. This measure decreased regeneration event intervals from four times per week to once every two weeks. The capital costs of the system and FDA validation testing and documentation totaled \$50,000. The investment had a four year simple payback.

Criterion Catalyst, Ltd.
Azusa, CA

SIC code 2819

This facility manufactures various types of hydrotreating catalyst which are sold to petroleum refineries. Petroleum refineries use these catalysts to remove sulphur and nitrates from crude oil. The various catalysts contain different metals such as nickel, cobalt, molybdenum and chromium.

Process

To form hydrotreating catalyst, an alumina oxide powder is first combined with water and metal additives to form a dough-like mixture. This dough is then run through an extruder to form spaghetti-like strands, which are then dried in a low temperature oven and pieced into small pellets. The material is then fully dried in a high temperature furnace. The catalyst support media is then cooled and screened to obtain uniform particle sizes. Some catalyst support media are impregnated with an acid or base solution after the dough-like material has been extruded, dried, pelletized, and sized. Following these steps, the material is again passed through a low temperature oven and a high temperature furnace. Fully processed material is screened again and is then packaged.

1994 Waste Stream Generation

Four waste streams generated at the facility were major routinely generated waste streams. The largest waste stream was wastewater generated from the nitrogen gas scrubbing air pollution control system (CWC 131- aqueous solution containing reactive anions; 1250 tons). Floor sweepings were the largest source of solid hazardous waste (CWC 352 - other organic solids ; 14.5 tons). Other waste sources included empty steel and fiber drums, and polyethylene drum liners (CWC 512/513 - container waste; 10 tons), and bags (CWC 591- baghouse waste; 5 tons) , undissolved residue from solution preparation (CWC 171 - metal sludge; 3 tons). Unlike Criterion Catalyst's sister facility in Pittsburg, California, off specification reclaimable product was not listed as a generated waste stream.

Source Reduction

Some of the Plan's measures had not been fully evaluated at the time the Plan was prepared. Measures listed in the Plan included studying whether or not there are benefits to replacing floor sweeping with pressurized water spray, segregating metal bearing floor sweep (dust) from nonmetal (non hazardous) bearing floor sweep, and replacing sweeping with vacuuming. The Plan indicates that the facility is

using supersacks with attached reusable liners for some customers as an alternative to using bags with disposable polyethylene liners. The expanded use of semi-bulk containers will be explored. The facility will explore installing an industrial shredder and bagwashing system to wash bags, shred them and dispose of them as non hazardous waste.

Past Source Reduction

Although individual waste type generation amounts, ranged from -17% to +35%, comparing 1990 with 1994, facility production increased by 150 percent (1990 vs.1994). The primary source reduction measure instituted at the facility was to replace open conveyors with enclosed conveyors to reduce waste collected from floor sweepings. The site also tests its water effluent on a monthly basis to determine if it is hazardous. If it is not hazardous, the water is diverted for reuse.

Criterion Catalyst, Ltd.
Pittsburg

SIC code 2819

This site's primary products are hydrotreating catalysts that are used by petroleum refineries and dehydrogenation catalysts that are used by facilities that manufacture styrene monomer. Hydrotreating catalysts are dry solids that contain alumina oxide, iron oxide and small amounts of other metals such as nickel, cobalt, or molybdenum. In refining processes, hydrotreating stabilizes products, or removes impurities, such as sulfur, by reacting the product(s) with hydrogen. Dehydrogenating processes remove hydrogen.

Process

To form hydrotreating catalyst, alumina oxide powder is formed into a dough-like material and mulled and extruded into different shapes and sizes. The extruded material is dried and saturated with a metal salt solution (acid or base). It is then dried again and packaged. The metal used in the solution varies depending on the category of catalyst being produced. To form dehydrogenation catalysts iron oxide is combined with metal solutions. Then the mixture is mulled, pelletized, dried in a high temperature furnace, size screened and then packaged as finished product.

1994 Waste Stream Generation

Off specification reclaimable product (CWC 141- off specification, aged, or surplus inorganics; 153 tons) was the site's largest waste type. The second largest waste type was CWC 132 - aqueous solution with metals; 127 tons, described as wash pad wastewater. Seven routinely generated waste categories were listed in the Plan; six were major waste streams. Sources of CWC 141 included extruder clean out material, baghouse dust, off-specification product and expired product, and fines and dust collected from plant clean up activities. Similar sources generated CWC 181- other inorganic solid waste except that the product being made was a nonchrome containing dehydrogenation catalyst. Wash pad wastewater

was generated from pressure washing die rings and rollers and other equipment in the plant. Other waste included CWC 512-empty containers, consisting of fiber or steel drums, and bags.

Source Reduction

A visit to the facility in December 1996 revealed that the facility was studying the possibility of drying, grinding, and reusing the material that is cleaned out from the extruder during extruder clogging events. Measures listed for implementation in the Plan included replacing fiber drums with returnable steel drums, segregating sweepings from the areas that contain metals and the areas that do not contain metals to facilitate in process recycling, and decreasing die ring washing to decrease wastewater generation. The Plan identifies a number of source reduction measures as needing further study. These included in-process recycling of baghouse dust for aluminum oxide product, installing conveyor belt guards to minimize product spillage, and installing low flow high pressure nozzles to wash equipment.

Past Source Reduction

Large waste stream category reductions were noted when comparing 1990 to 1994. Most of the reduction appears to be the result of intensified efforts to conduct in-process recycle of excess product, product dust, off specification product, and sump water (that has been collected in settling tanks) as process make up water. Between 1990 and 1994 a fines grinder was installed, and this greatly increased the facility's ability to internally recycle excess or off specification product. Prior to this improvement, a significant portion of the waste was sent off site for metal recovery. Equipment costing \$1 million was installed to enable dust from the dust collection to be collected and recycled into product batches. Although not source reduction, wastewater disposal is reduced by collecting wastewater from equipment clean up and storing it into one of two above-ground tanks depending upon its pH. As noted above, some of the water is used in the manufacturing process.

Dexter Hysol Aerospace
Pittsburg, CA

SIC code 2891

This facility produces paste adhesives systems (resins and hardeners), epoxy film adhesives, syntactic film core materials, composite surfacing films, and corrosion inhibiting primers used in conjunction with the epoxy film adhesives. Aerospace and aviation companies are the firm's major customers.

Process

To produce batches of product polymers are compounded or reacted in various sized vessels with additives and solvents. Process mixtures range from thin liquids to viscous pastes and various solvents are used as diluents. The facility also batch produces water-based primers in dedicated vats and mixing tanks. Methyl ethyl ketone (MEK) and methanol are the primary solvents used in product formulations and for cleaning equipment. There is a small on-site distillation unit which recovers MEK. This recovered material is used for parts washing. Di-basic ester is also used for cleaning.

1994 Waste Stream Generation

The largest waste stream produced at the site was CWC 272 - polymeric resin waste ; 97 tons, generated as off-specification product, expired excess product, and still bottom residuals. Spent solvent cleaning solutions that were used to clean reactors, mixing vessels, and small parts and equipment were classified as CWC 212- oxygenated solvents; 25 tons. Another significant waste stream was rinsate (CWC 134- aqueous solution with total organic residues < 10 percent) that generated from cleaning the vessels used to produce water based primers. This water based primer equipment was manually wiped clean, and then sprayed with deionized water in the form of high pressure steam.

Source Reduction

The primary source reduction measure implemented at this facility was to develop a water-based adhesive primer as a replacement product for its solvent based adhesive primer. Dexter has worked with one of its major customers, the Boeing Company, to qualify and subsequently use the water based primer as an alternative. This action reduced MEK spent solvent waste and also reduced VOC emissions at the site. Over the next several years the firm hopes to minimize the production of solvent based adhesive primers by convincing other customers to test and accept water based primers.

To reduce spent cleaning solvent waste and wastewater rinsate, first rinse solutions generated from primary cleaning of vessels are used as make up ingredients for subsequent batches of similar product. Spent MEK is decontaminated in an on-site still and used as a substitute for virgin solvent cleaning solution. Quality control samples are reworked into subsequent batches. The firm also indicated that it has reduced the number of container sizes it offers to customers, implemented a returned goods policy and eliminated speculative production. To reduce hazardous waste from cleaning water based primer production vessels, the facility plans to test rinsate waters to determine if the rinsates are hazardous or non hazardous for segregation and separate management.

Past Source Reduction

Dexter Hysol s Plan discusses various cleaning methods that were tested to clean reactor vessels to reduce solvent and rinsate wastes. These methods, which included using crushed walnut shells , carbon dioxide pellet blasting, and hot nitric acid rinses were rejected because they did not achieve the desired level of cleaning needed to prevent cross-contamination. The Report indicated that one hazardous waste stream generated in 1990, sludge and anodizing rinse water (CWC 132), was eliminated by discontinuing chromic acid anodizing and replacing it with phosphoric acid anodizing. Anodizing rinse waste is generated from preparing aluminum pieces used to test the strength of Dexter s adhesive products. The firm also reported that to reduce spent MEK, di basic Ester, which the firm considers less hazardous, is now used in most wipe cleaning applications and also in the parts washer.

Dow Chemical Pittsburg

SIC codes 2879, 2819 and 2821

When the 1995 Plan was developed, nearly 70 percent of the facility's production was industrial organic chemical products. Agricultural chemicals, (final and intermediate products) which include fertilizers, herbicides, and fumigants, now account for nearly 90% of the production at Dow's Pittsburg facility. Other products produced at the site include two grades of preservatives, one for paints, oils and lubricants, and the other for personal care products, and 13 varieties of latex polymer-based coatings. Hydrochloric acid and refined carbon tetrachloride products made by this facility originate as unrefined co-products from the site's agricultural chemicals production processes. This facility also makes brine salts and semi-permeable membrane cartridges. The brine salts are used to regenerate ion exchange resins and the cartridges are used to purify water and to separate nitrogen from air.

Process

Agricultural-herbicide chemical intermediates and final products from this facility are batch produced using reaction vessels configured in series. Reaction sequences are referred to as alpha or beta depending upon the end product or intermediates that are produced. Both of these processes involve reacting chlorine and picoline vapors in liquid phase reactors, cooling and separating substances, distilling process streams, continuing phased chlorination reactions, further distillation, and finally formulation. Generally described, the process starts when raw picoline is dried and then reacted with chlorine. The pyridine vapors from this reaction are cooled to a liquid state, mixed with vaporized chlorine in reaction, and then distilled. Distillation produces byproducts such as hydrochloric acid, process tars - the site's largest waste stream, and light to heavy intermediates which are separated and routed to specific reactors. The process mixture is further chlorinated after which it undergoes final distillation and formulation in which additives are incorporated. Latex polymers are produced using the emulsion polymerization process that involves using emulsifying agents to disperse raw materials in water during the polymerization reaction. The reacted styrene-butadiene mixture is then steam stripped, cooled, and filtered and/or extruded. The site uses process water and groundwater to produce high quality boiler feed water and a brine solution that is used to regenerate the water purification ion exchange resins..

1994 Waste Stream Generation

The largest generated wastes by waste code designation was CWC 135 - unspecified aqueous solution; 6500 tons. CWC 135 is largely acidic wastewater that is primarily generated from water purification operations, and from the site's emissions scrubber system which uses an alkali solution to neutralize acidic gases that originate from the refinement of crude hydrochloric acid. The second largest waste stream was CWC 751- solids or sludges with halogenated organic compounds ≥ 1000 mg/Kg ; 2115 tons), generated from cleaning internally contaminated vessel hardware, and dust and excess or off-specification product and carbon tetrachloride distillation bottoms from agricultural product production processes. Another large waste stream was CWC 741 - liquids with halogenated organic compounds \geq

1000 mg/L; 1075 tons). CWC 741 wastes included solvents, and sludges with halogenated organic compounds. The significant sources of these wastes were solids cleaned from reactor vessels, and residuals from purifying carbon tetrachloride. CWC 343- other organic liquids was the fourth largest waste code category by quantity; 240 tons. This waste is generated from raw material and product purification steps in the speciality chemicals and agricultural chemicals production processes. Other wastes included spent solvents from vessel cleaning, off specification methyl ester products, containers, drums and personal protective equipment.

Source Reduction

The Plan listed the following source reduction measures for implementation: install a new cleaning station which uses N-methyl pyrrolidone instead of methylene chloride to clean the spinnerette dies used to extrude Generon[®], a polymer, institute in-process recycling of off-specification methyl ester to reduce CWC 751 waste by incorporating this dry material into a slurry to reintroduce it to the reactor, and modify internal reactor hardware to reduce the need to clean out the reactor solids and also to reduce formation of the solids which contribute to the CWC 751 waste stream. Also listed, although not a source reduction measure, was recycling wet picoline left over from the picoline drying process by returning it to the vendor to reduce CWC 343 waste.

Past Source Reduction

The Management Performance Reports lists a number of implemented source reduction measures and estimates an 243 ton annual reduction in hazardous waste generation since 1990; however the report acknowledges that production has declined since 1990, and fewer products are now made with a greater share of production allocated towards intermediate and end use agricultural products. Some waste types were also reclassified (making comparison between 1990 and 1994 more difficult) and one chosen measure related to materials handling no longer applies because significant raw materials are now received by railcar instead of truck. Specific measures included; installing an acid gas vapor recovery system to condense and recover acid gases for reuse. These gas vapors are generated when equipment is shutdown and evacuated to perform maintenance; estimated reduction 89 tons annually of CWC 122 - alkaline solution without metals. CWC was a major waste stream in 1990. A second measure to reduce CWC 122 involved installing equipment and piping for unloading raw materials shipped by truck. A pump replaced the method of unloading which relied on using nitrogen pressurized gas. After the gas was used it had to be vented to the scrubber for neutralization using a salt solution. To reduce process tars, piping modifications were made, following an engineering feasibility study, to enable some reaction catalysts to be internally recycled in the process, thereby decreasing the amount of fresh catalyst needed and achieving a reduction of 888 tons annually of CWC 341 - nonsolvent organic liquids with halogens, waste. This project also resulted in installing additional piping and equipment which optimized yields by allowing internally recycled process streams to be separated and reused based on different temperatures, pressures and catalyst concentrations. Other measures included improving pump seal reliability to avoid leaks, installing high performance valves on reactors to hold material in lines and tanks during maintenance activities, replacing flange gaskets with more reliable gaskets that have an

improved design and construction material, and installing Isolock ® brand sample valves to reduce sample sizes taken for quality control purposes.

Dupont Antioch Works**SIC code 2816****Antioch**

This facility produces titanium dioxide pigments, and formerly produced Freon 11 and 12. Freon manufacturing ceased in April 1995; however, the site blends and packages Freon refrigerants received from other Dupont facilities. Titanium dioxide pigment is used in paints, plastics, inks, and paper products. Freon 11 and 12 have been used as solvents in the electronics industry and Freon is also used in medical products and fire protection equipment. This facility sells treated encapsulated waste metal chloride sands as a commercial road base product. This practice is an issue that is currently under review by the Department of Toxic Substances Control.

Process

Freon was manufactured in a continuous process that involved chemically reacting liquid carbon tetrachloride and hydrogen fluoride in the presence of a fluorinated catalyst. Hydrochloric and hydrofluoric acid byproducts created in this process were removed using low temperature distillation. The Freon was then scrubbed with an alkaline solution to remove any remaining hydrogen fluoride and then dried.

Titanium oxide is a white substance which comes from titanium ore sands. The sand is first chlorinated in a reactor to create gaseous chlorinated metals including titanium tetrachloride. Initial impurities are removed by temperature controlled vapor condensation which separates out the titanium tetrachloride based on its unique volatility. Carbon tetrachloride is then added to further purify the condensed titanium tetrachloride. Titanium tetrachloride is then converted to titanium oxide by vaporization and reacting it with oxygen at high temperatures. The product is then washed, filtered, dried, sized, and packaged.

1994 Waste Stream Generation

The largest generated waste stream was metal chloride sands (CWC 792 - liquids with $\text{pH} \leq 2$ with metals) which consists of impurities that are removed during the chlorinization process ; 24,900 tons). This condensed residual forms a slurry that is solidified with concrete. Solidified material is then crushed to form a commercially available road base material. Spent antimony pentachloride catalyst is also generated in the chlorinator; 2.4 tons annually. Another waste generated from the chlorinization process is CWC 791- liquids with $\text{pH} \leq 2$; 3050 tons). Waste gases, which condense as liquid hydrochloric acid (HCl), are formed in the chlorination step when hydrogen is added and this material reacts with water hydrides. Some hydrochloric acid is recycled in the process. The remainder is

neutralized and discharged to the local wastewater treatment facility. The other routinely generated waste stream was alkaline fluoride (CWC 121- alkaline solution (pH \geq 12.5) with metals; 279 tons. This waste was generated in a Freon purification step.

Source Reduction

The Plan listed the following measures: reduce the amount of water introduced into the process at the SR point to reduce annual HCl waste generation by 115 tons and also reduce water content of a solution that is added in the oxidation step of the process. The water component of the solution eventually is converted to HCl; therefore, by increasing the concentration of the solution the amount of water would be reduced, and hence the amount of HCl would be reduced. Also listed as measures were to investigate the use of sodium hydroxide solution as an alternative to water to reduce the generation of HCl waste. A last item listed was to continue research on replacing sulphuric acid with hydrochloric acid in the finishing phase of production as opposed to handling it as a waste outside the process.

Past Source Reduction

The site installed a new gas scrubber system in 1986. As noted above, gas scrubbing was described as a purification step in Freon manufacture. The result was a reported 87 percent reduction in fluoride wastes generation. In 1988, a purer form of carbon tetrachloride began to be used in the chlorination reactor. Before the change, the reactor had to be periodically purged (cleaned) of accumulated contaminants that originated from the raw material. This reactor cleaning waste stream has been eliminated but the quantity affected is unknown.

Waste use and recycling

In 1987 the facility began using a low arsenic content hydrofluoric acid and coupled this with process modifications to utilize the waste acid as a product they refer to as 12/3 acid. Some acid waste began to be recycled back into the process. Details regarding who buys 12/3 acid and what it is used for were not reported in the Plan. Waste metal chlorides (CWC 792) the site's largest waste stream (approximately 49 million pounds in 1994) is encapsulated with concrete and then crushed and sold as road base material that Dupont calls Sierra Crete. No potentially feasible source reduction opportunities were evaluated for this waste stream. Spent catalyst is returned to the supplier for reprocessing. This practice began in 1989 as an alternative to land disposal.

General Chemical
Richmond

SIC code 2819

This facility produces various grades of sulfuric acid. In partnership with an adjacent Chevron petroleum refinery which uses the acid as a alkylation catalyst, fresh acid is sent to the refinery and spent acid is returned via pipeline to General Chemical for reprocessing. General Chemical also produces sulfuric acid for other markets including companies that produce detergents, fertilizers, and batteries.

During 1996-1997, facility additions established the Electronic Grade Sulfuric Acid Process to produce electronics industry grade sulfuric acid.

Process

Spent sulfur and acid enters two brick-lined chambers in which the material is vaporized and reacted at 1800° F to decompose the stream into sulfur dioxide (SO₂), sulfur trioxide (SO₃), water and oxygen. The hot gases cool in a packed tower after they have been saturated with sulfuric acid mist and impurities such as excess water and particulates have been removed using electrostatic precipitators. Clean process gas is then reacted with air in catalytic converters containing vanadium catalyst to form sulfur trioxide (SO₃). The SO₃ is then absorbed and reacted with water (hydrated) in four towers to form sulfuric acid and oleum (concentrated sulfuric acid containing excess available sulfur trioxide). The acid is cooled and then stored. The oleum is transferred to the Electronic Grade Sulfuric Acid Process.

1994 Waste Stream Generation

Unburned or partially combusted organic material in the spent acid forms carbon wastes (CWC 571- fly ash, bottom ash; 4-6 tons/year) and several operational factors can contribute to generating this waste inadequate temperature control or atomization of droplets, and inefficient chamber operation during periods of startup, shutdown, or upset conditions. Fly Ash (CWC 571- also classified as CWC 181 - other inorganic solid waste) is a powdery residue in the boiler which contains trace metals. It is generated from the erosion of brick linings, corrosion of boiler tubes, and from burning inorganics. Sand blast grit and spent refractory brick both contain traces of metals. Bricks are the largest waste stream (69%); however, generation rates fluctuate from year to year depending upon brick replacement needs.

Source Reduction

No feasible source reduction measures were identified in the source reduction Plan, although source reduction categories were addressed for each major routinely generated waste stream.

Past Source Reduction

The Management Performance Report indicated that decomposition control system improvements upgrading the method by which acid is injected into the decomposition chamber help reduce likelihood of producing droplets too large to decompose during combustion. The facility has experimented with using CO₂ cleaning to replace using crushed walnut shells to remove fly ash from the inside of their boilers. This effort was unsuccessful. Repairing leaking pipes and equipment in a more timely manner has helped to significantly reduce generation of sulfur dirt and debris collected from housekeeping activities.

Notes: DTSC manifest records indicate that manifested waste totals in 1990 were 23.8 tons and in 1994

were 352 tons. A large factor in this increased waste generation was replacement of decomposition chamber bricks which occurs at varying intervals; an ongoing brick replacement program began replacing the discrete brick replacement efforts in earnest in 1993.

Genetech
South San Francisco

SIC code 2834

Genetech manufactures six medicinal products in the form of high purity liquid solutions or powders that contain proteins developed by recombinant DNA technology. These products are used in treating heart attacks, strokes and cystic fibrosis, and also to treat children's hormone deficiencies. Other products produced by Genetech are awaiting FDA approval or are in research and development phases including clinical trials.

Process

DNA containing genes that code for a desired protein are introduced in host bacterial or mammalian cells. The type of cell chosen depends upon the complexity of the protein and concentrations of protein needed. Cell growth is stimulated by placing the cells in fermentation vessels in which nutrients and other substances are added. Typically starting out in a small vessel, once concentrations have reached a certain point, the cell culture is transferred to a larger fermentation vessel to produce a batch. Upon reaching production scale, the proteins in the cell culture fluid are extracted or separated. In mammalian cells, the culture fluid which contains the protein is filtered to remove cell debris. In bacterial cells, the protein exists in the cell membrane and must be removed by first breaking open the cells; in some cases this involves using chemical solutions. The culture fluid is then centrifuged or filtered to remove cell debris. Following these steps, remaining cell culture impurities are removed using chromatography (based on differences in migration properties) or by ultrafiltration (based on differences in size). Liquid products are then packaged in medical vials. Some products are converted to a powder using a dehydration process.

1994 Waste Stream Generation

The facility produced five major routinely generated waste streams the largest being aqueous corrosive wastes (CWC 122 - alkaline solution without metals; estimated generation 10,000 tons) generated from flushing procedures that chemically regenerate the resin beds used to produce deionized water, and from cleaning equipment including pipes and production tanks used in manufacturing. Other wastes included dilute sodium solutions (CWC 134-aqueous solution with total organic residues < 10 percent; 139 tons) generated from chemically breaking open cell membranes to extract proteins, (CWC 214-unspecified solvents; 93 tons) generated from high pressure liquid chromatography experiments which use solvents as either carriers, washing agents or elution buffers. Other significant waste streams included glassware and lab packs. Corrosive wastewater is neutralized by adjusting pH and discharging to the publicly owned wastewater treatment facility. The remaining waste streams are incinerated or landfilled.

Source Reduction

To reduce corrosive wastewater originating from regenerating resin beds in the deionization units, the facility has installed a reverse osmosis (RO) system which significantly extends the intervals between regeneration cycles. The facility also maintains two deionization (DI) systems that previously provided all water treatment needs. Now, during peak water demand periods the DI systems are used only to augment RO capacity. The onsite DI system is now regenerated approximately once every two weeks instead of one to two times per week. This has reduced annual waste generation from an estimated 200 tons to 83 tons. A second RO unit is being considered in conjunction with another deionization unit at the site to achieve further reduction. One advantage of the RO units is that they remove silica from city and well water whereas the deionization units do not effectively remove this contaminant. If silica contamination is too high deionized water, which is distilled following deionization can be rejected because of failure to meet purity standards. Another implemented measure involved installing roofs over waste solvent storage tanks to reduce rainwater accumulation in the secondary containment zone around the tanks. This water was previously collected and handled as hazardous waste. This \$4000 dollar investment had a seven month payback and reduced annual waste (CWC 214- unspecified solvents) by 2,500 gallons. To reduce solvent waste from small parts cleaning, the facility replaced its existing system with a vendor-supplied system which reduced waste by approximately 25% due to the new system's smaller chamber size. One of the products made by Genetech uses sodium thiocyanate in a protein isolation step. The firm has identified, and is investigating the feasibility of using a possible replacement for this chemical that is considered less hazardous when used in low concentrations.

Past Source Reduction

No source reduction measures of notable significance were implemented between 1990 and 1994 with the exception of work to increase product yields (called titers). This work was significant for two particular products; corrosive wastewater generation was reduced by decreasing the frequency of cleaning conducted between batch campaigns, however specific benefits were not quantifiable with production (normalized) due to the large number of variables which affect waste generation. For example, kilograms of product produced comparing 1990 to 1994 increased by nearly 500 percent and the number of batches produced comparing the same periods increased by about 100 percent and corrosive wastewater generation increased by an estimated 325 percent. In several of the site's various departments certain source reduction strategies were attempted to a limited degree with variable success which included use of non hazardous cleaners for parts cleaning, sharing excess chemicals between labs, and cleaning and reusing gels for experiments.

GNB Technologies
City of Commerce

SIC code 2819

This facility produces a lead oxide paste used to produce lead acid batteries. The product is sold as a powder. A significant portion of the raw material used by the facility comes from used lead acid batteries.

Process

Large one ton ingots are lowered into a melting pot in which the material is heated to a molten state. The molten lead flows through a pipe into one of eight reactor vessels at the site. The rate at which molten lead enters the reactor is controlled by the hoist which lowers the ingot into the melting pot. An agitator in the reactor beats the molten lead into a mist of small droplets. An air flow induced into the reactor combines with the heat to oxidize the lead which forms as a powder as it is oxidized. The air draws the powder out of the reactor into a baffle classifier which segregates the particles by size. Large particles are returned to the reactor. Small particles pass to the cyclone separator. At the end of the oxidation process, about 25 percent of the lead entering the reactor does not oxidize. From the cyclone separator, lead particles are conveyed to the baghouse. From the baghouse the material is conveyed to a bucket elevator which drops the material into a grinding mill. The grinder sizes the material to customer specifications. The ground product is then air conveyed to storage bins. Shipping containers on trucks are filled from the bin via gravity flow.

1994 Waste Stream Generation

Four waste streams, all classified as CWC 181 - other organic solids ; 54 tons, were listed as major routine waste streams. Waste sources included spent baghouse filters, melting pot dross, scrap from pot cleaning, sludge, lead contaminated drums and expired machinery and machinery parts, HEPA filters, and packaging debris. Baghouse filter failure (generating filter waste) was attributed in part due to the wide temperature variations of the lead oxide laden air that passes through the filters. Other routine wastes included lead acetate solution (CWC 724 - liquids with lead ≥ 500 Mg/L generated from laboratory quality control operations ; 2.7 tons). Total routine waste quantity was 56.5 tons.

Source Reduction

The Plan s listed source reduction measures included improved waste segregation and testing the use of HEPA filters that do not contain aluminum. This latter measure (not source reduction) would make it possible to recycle the filters rather than ship them for landfill. Using Gortex filters that have a four year life, rather than the two year life of the currently used filters, was researched, but found to be economically infeasible. Also listed in source reduction measures was discontinuing the production of re-refined lead from hard lead which contained antimony alloy; this eliminated dross and of f-spec re-refined lead. Better housekeeping was listed as a measure but it was not specific as to detail nor its beneficial effect.

Past Source Reduction

No feasible source reduction measures were identified. Department of Toxic Substances Control (DTSC) manifest records lists 59.5 tons of hazardous waste shipped offsite in 1990 versus 690 tons shipped offsite in 1994. This increase was primarily caused by waste that was generated from non routine construction activities in 1994. Comparing the two periods, waste streams were reclassified and new wastes were recognized in 1994 because of waste segregation and/or improved waste accounting

practices. In 1990, this site shipped lead debris to another GNB site to recover recyclable material and the residual material was incinerated. DTSC required GNB to cease this practice. The Report indicates that production increased comparing 1990 to 1994, but the increase was not quantified. About half of the waste generated was managed by recycling; the rest was landfilled

Henkel Corporation - Chemicals group
Los Angeles

SIC code 2899

This facility produces oleochemicals, which are fatty acids derived from natural fats and oils such as coconut, canola, palm kernel, soybean oil, etc. Natural fats and oils are triglycerides containing three fatty acid molecules combined with a glycerine molecule. These products are used in adhesives, cosmetics, papers, pharmaceuticals, and shampoos. Coconut oil is a principal raw material feedstock. The facility also produces methyl esters and purified glycerine. Many of the facility's products are Kosher, and are manufactured under Rabbinical supervision.

Process

Raw materials (natural fats and oils) are reacted with water in a hydrolysis reaction to split the fats and oils into mixed fatty acids and dilute glycerine. The fatty acids are routed through vessel that separates the fatty acids from the residual water in the mixture. Some of these fatty acids then undergo hydrogenation, which converts unsaturated fatty acids into saturated fatty acids. Nickel is used as a catalyst for the reaction, which occurs in a single batch autoclave. The intermediate product from this unit is then filtered with a plate and frame filter press using diatomaceous earth as a filter media. After filtering, the intermediate product is either distilled or fractionalized (separated based on differences in solubility and boiling points) to achieve the proper purity and mixture prior to shipment to a customer. Natural fats and oils are also reacted with methanol to produce methyl esters and glycerine. The glycerine is then purified through a deionization unit, similar to those used to deionize water. The methyl esters are separated into individual esters via fractionalization and then further purified.

1994 Waste Stream Generation

The largest routinely generated nonaqueous hazardous waste was spent nickel catalyst (CWC 162 - other spent catalyst; 123 tons). The spent catalyst is a cake-like substance containing diatomaceous earth. Beginning in 1992, the spent nickel catalyst waste (containing 4% nickel) was sent to an out-of-state smelting operation, and used as a substitute for nickel ore instead of being landfilled. The site's other routine non aqueous hazardous waste stream was sump waste (CWC 611 - contaminated soil) which contains traces of nickel, dirt, debris, rainwater, process water, oil and fatty acids. Acidic wastewater, the site's largest waste stream (387,000 tons of CWC 135), was generated from onsite regeneration of resin beds in the deionization unit that is used to produce purified glycerine. After pH adjustment, this waste stream is discharged to the POTW.

Source Reduction

The Plan states that there is ongoing experimentation to optimize process efficiency (product specific) by reducing the use of catalyst and filter media. These efforts have resulted in a 2% reduction in waste nickel catalyst generation. A process modification, using fixed bed catalyst (a catalyst resides on a plate inside the reaction vessel and does not have to be filtered out of the process stream) and an input change, using palladium as a replacement catalyst, were reviewed but these options were rejected for economic reasons.

Past Source Reduction

The facility eliminated the use of 1,1,1 trichloroethane by replacing it with a non-hazardous water-based degreaser used in maintenance operations.

Kelco Company San Diego

SIC code 2869

This facility produces granular and fibrous powder alginate products and also xanthan gums. The raw material for the alginate products comes from sea-harvested kelp. Xanthan gum is produced as a cream colored powder. Alginates and xanthan gums are classified as hydrocolloids because they act as thickeners and stabilizers. These substances are used in food and beverages, and they are also used in other products such as textiles, paper, and oil drilling fluids.

Process

As is briefly described in the Plan, kelp is unloaded at the facility and is chopped, washed, cooked, and clarified to remove insoluble matter. The remaining algin is then dried and milled. Xanthan gum is produced from a pure-culture fermentation process known as biopolymerization pioneered by Kelco, using the microorganism *Xanthomonas*. The fermentation process grows the microorganism in an well aerated environment which contains carbohydrates, protein, and salts. Once the fermentation process is complete, the xanthan gum is separated from the medium. It is then dried, milled and tested to verify product specifications prior to packaging.

1994 Waste Stream Generation

The facility's two major routine waste streams were waste oil generated from oil change outs for various compressors, pumps and gear boxes (CWC 221 - waste oil and mixed oil; 12.7 tons), and oil contaminated solids generated from site housekeeping activities (CWC 223 - unspecified oil containing waste; 9.9 tons). Oily solids are managed by incineration. Some liquid oil waste is recycled off site.

Source Reduction

The facility rejected use of synthetic oils for economic reasons, and also rejected offsite laundering of oily rags to enable the rags to be reused. Burning used oil in boilers (not source reduction) was also

listed as a rejected option. The facility has chosen to use drip pans to collect oil from leaks and this will minimize the need to use of absorbent which contributes to the waste quantity. On a trial basis, the facility began using the oil collected in drip pans to lubricate leacher chains, but the results were unsatisfactory and the practice was discontinued.

Past Source Reduction

This was the company's first SB 14 Plan. As such, the Management Performance Report did not include a retrospective discussion regarding source reduction measures implemented during a previous SB 14 planning period.

Lonza
Los Angeles

SIC code 2834

Lonza produces active proprietary ingredients that are used in medicines and chemical intermediates used by other manufacturers for further processing and/or incorporation into end-use products. Some specific products/substances manufactured at the site in 1994 included biotins, dextromethorphan hydrobromide, and triprolidine hydrochloride.

Process

Ingredients are added in precise quantities to reaction vessels varying in size from 300 gallons to 4000 gallons which are used individually, or in series. Typically, process mixtures are reacted in several steps. Reaction sequences depend upon the specific chemical reagents that are used. Organic solvents are important substances used in chemical synthesis. Some process mixtures are reacted in vessels that have reflux columns or tube type condensers. These condensers connect to pipes that channel internally recyclable material to receiving containers. Not all reactors have condensers; reaction process byproducts may be reused in the process or be routed to waste receiving tanks or temporary storage holding tanks depending upon the product being synthesized which affects the solvent content of aqueous waste exiting the reactor(s). Process mixtures are typically agitated during reactions and filtered after exiting the reactors using centrifuges, vacuum filtration, or pressure filters. Mother liquor is sometimes recovered from the filtration step for reintroduction into the process. The product exits the filter as a wet cake and is then dried in either a rotary tumble, a vacuum tray, and/or fluid bed dryer. Some dried products are size-screened to achieve particle size homogeneity.

The site has an air pollution control system which scrubs emissions using sodium hydroxide. Spent solutions from air pollution control scrubbing are treated and then discharged to the POTW. Fugitive dust is captured in a baghouse.

1994 Waste Stream Generation

Spent solvent generated from chemical synthesis reactions was classified as either CWC 214- unspecified solvent, or CWC 212- oxygenated solvents ; 983 tons. Solvents are distilled off reactor vessels and were segregated as a blended toluene waste stream which was shipped offsite for fuel blending, or a general solvent waste stream which was shipped off site to a treatment, storage and disposal facility.

Wastewater was classified as CWC 134 - aqueous solution with total organic residues < 10 percent ; 38,750 tons. The primarily source of the wastewater was process water. As noted, some mother liquors recovered from filtrate, condensed solvents, and distilled process water is collected and reused in the chemical synthesis process. Typically, process wastewater is distilled and discharged to the publicly owned treatment works (Publically Owned Treatment Works). To discharge to the Publically Owned Treatment Works the wastewater must meet specifications required by the facility discharge permit. In cases where the wastewater does not meet discharge specifications, it is redistilled. Non process wastewater is generated from cleaning plant equipment using high pressure spray washers. This wastewater is also discharged to the POTW. Sludge waste, classified as CWC 241- tank bottom waste; 49 tons, contains grit, oil, dirt, and water was generated from cleaning and rinsing of sumps, tank bottoms, and clarifiers .

Source Reduction

The Plan mentions that changing the operational methods used to clean tanks, sumps, and clarifiers to use less water was considered and will be considered in future plans in more detail; the current method uses high pressure water. The initial proposal was to first clean equipment manually before cleaning with high pressure spraying to reduce wastewater generation. The primary impediment to changing tank and vessel cleaning methods has been worker safety concerns. The economic benefits of the proposed changes were also not fully evaluated. Although not mentioned in the Plan, this facility won a contract (1996) to produce a new grade of products. As a result, some reaction vessel piping, exhaust systems, and manifolds underwent extensive upgrading.

Past Source Reduction

The Management Performance Report states that the organic constituents of wastewater discharged to the sewer decreased by 5.6% when comparing 1990 with 1994.

Medeva (MD) Pharmaceuticals
Santa Ana

SIC 2834

The primary product produced at this facility is methylphenidate hydrochloride, sold and distributed by the firm as tablets. Threo acid, an intermediate chemical, is also produced by the facility. Methylphenidate hydrochloride is a drug used to treat attention deficit disorder.

Process

Acetic acid, catalyst, and raw materials are charged into the first of several reactor vessels. Hydrogen gas is then added after air has been evacuated and the process mixture is heated to begin the hydrogenation reaction. Hydrogen is maintained in excess during the reaction. When the reaction is complete, the mixture is cooled and transferred through a sealed pressure filter and into a second reactor vessel for acetic acid distillation which is then collected in another reactor. After the acetic acid is distilled from the reaction mixture, a solution of isomers of acetate salt remains and is transferred through a pressure filter and into another reactor. Sodium hydroxide is added and heat is applied to complete the conversion of the reaction mixture to threo acid sodium salt. After the converted product is cooled, the salt is collected via centrifugation. The recovered salt is then dissolved in water and the solution is neutralized with hydrochloric acid. The threo acid is then isolated using the centrifuge, rinsed with water and then dried in a fluid bed dryer.

In final synthesis, methanol is added to a reactor along with the dried intermediate and hydrogen chloride. This mix is filtered as it is transferred to another reactor where additional methanol and hydrogen chloride is added. Heat is then applied. When the reaction is complete, the batch is cooled. Diethyl ether from another vessel is filtered and then added to complete the crystallization process. The chilled slurry is then filtered using a centrifuge and following this step the filtered material (cake) is washed with cold ethanol. The cake is then dried in a fluid bed dryer. Dried methylphenidate hydrochloride product is blended with other ingredients, formed into tablets and then packaged.

1994 Waste Stream Generation

Three major routine waste streams were generated by the facility which included spent solvents from chemical synthesis of the final product (CWC 214- unspecified solvents; 41.5 tons), aqueous sodium hydroxide, (CWC 122- alkaline solution without metals; 45 tons) generated from intermediate product synthesis, and spent acetic acid (CWC 791 - liquids with $\text{pH} \leq 2$; 25 tons) also generated from synthesis of intermediate product. Routine waste generation increased from 30 tons in 1990 to 116.5 tons in 1994. However, methylphenidate hydrochloride production increased by a factor of 5.3. Two products and their intermediates, triprolidine and diphenoxylate, were produced during 1990, but were not produced in 1994. Two major routinely generated waste streams are managed by off site incineration, the third major waste stream is managed by shipping it offsite where it is blended for fuel use. A non major routine waste stream, spent palladium catalyst, is shipped off site to a recycler who recovers palladium metals. Wastewater, described as nonhazardous and containing salts and minor quantities of alcohol is discharged to the local publically owned treatment works.

Source Reduction

The only source reduction options listed the Plan, were characterized as good housekeeping and inventory control. These commonly used terms were not defined any further as to what specific improvements were envisioned. The Management Performance Report mentions operator training and keeping on site inventory to minimal levels. The original Plan stated that the firm would evaluate using less solvent and substituting solvent type in the final synthesis phase of production and complete this

evaluation by January 1998. The Management Performance Report mentions that dedicated equipment was purchased to produce threo acid as a measure which should result in waste reduction, however, the Plan does not discuss this measure to describe how the waste reduction will occur.

Past Source Reduction

None were reported.

Morton Electronic Materials Tustin

SIC code 2899

Morton Electronic Materials facility formerly processed chemicals that are used by the electronics manufacturing industry; primarily liquid intermediates used by semiconductor manufacturers for the photo resist process. Specific substances produced were not listed.

Process

The Plan briefly mentions that blending, filtering, and packaging are the operational processes conducted at the site.

1994 Waste Stream Generation

The site lists six major waste streams in 1994 in order of quantity; process waste water (CWC 135 - unspecified aqueous solution; 55 tons), dry film (CWC 272 -polymeric resin waste; 27 tons), liquid solvents (CWC 214-unspecified solvents; 19 tons), flammable solid debris (CWC 352 - other organic solids;15 tons), flammable liquid waste (CWC 214-unspecified solvents; 8.25 tons), and crushed glass (CWC 181 - other inorganic solid waste; 12.3 tons).

Source Reduction

No source reduction measures were listed. The site manager indicated that the site had ceased manufacturing in December 1994 and that only research and development activities currently occur at the site.

Past Source Reduction

No previous source reduction measures were listed, described or evaluated. The Management Performance Report also did not indicate how waste streams were disposed/managed; but the Plan did.

Nalco Chemical Carson

SIC code 2869

Nalco Chemical s Carson facility produces approximately 100 water-based and solvent-based products.

The primary line of products are water treatment chemicals that condition water used in steam boilers, cooling towers, and wastewater treatment units. The facility also makes chemicals that are used to treat crude oil such as demulsifiers, scale inhibitors, and corrosion inhibitors. Other specialty chemicals are also produced by Nalco that are used by the petroleum, paper, and steel manufacturing industries.

Process

Different combinations of liquid and solid raw materials such as solvents, oils, resins and dry additives are pumped, or manually added to one of five mixing/blending vessels including a reactor vessel containing a vapor recovery unit. Ingredients are mixed and heated in the reactor vessel under pressure. After reacted mixtures exit the reactor they are cooled. Samples from blended or reacted batches are collected for onsite quality control analysis. Each product batch is checked by fourier transform-infrared analysis to insure that contaminated material is rejected. Reactor vessels contain coils or jackets that use water for heat transfer. Finished products are packaged in pails, drums, totes, stainless steel canisters, bulk tanks, or truck tanks.

1994 Waste Stream Generation

The facility's largest waste stream was wastewater generated from process equipment cleaning, portable tank cleaning, and floor cleaning (CWC 134 - aqueous solution with total organic residues < 10 percent; 1650 tons). The largest single source of the waste is rinsate from Porta-Feed[®] product container cleaning which is accomplished manually. The wastewater, which contains dirt, traces of process chemicals and oils is treated to adjust pH and then discharged to the Publicly Owned Treatment Works. Sludge residual from on site wastewater treatment (a non source waste) is manifested for land disposal. Oil/Solvent waste (CWC 221- waste oil and mixed oil; 18 tons) was generated from flushing product transfer lines, hoses and rinsing tanks that contained oil-based products. The third routine waste stream was production trash (CWC 181-other inorganic solid waste; 14 tons) which contains samples, empty bags, containers, and personal protection equipment.

Source Reduction

Nalco's revised source reduction Plan discusses plans to replace a manual cleaning system used to clean Porta Feed[®] containers with a high pressure automated washing system to achieve a possible 10 percent reduction of waste from this source. The facility investigated the feasibility of purchasing raw materials in supersacks to reduce fiber drum container waste, and purchasing Porta Feed[®] containers to enable temporary storage of equipment rinsate so that it could be used as charge material for future batches of the same water-based products, but determined that these potential measures were economically infeasible.

Past Source Reduction

To reduce oil and solvent mixture waste, Nalco instituted a rinse and hold approach for organic/solvent based products which involves capturing and storing the rinsate from cleaning equipment and lines, and using it as charge material for the next batch of the same product. In 1992, the facility installed

dedicated oil product transfer hoses to reduce the number of equipment rinses which generate oil and solvent wastes. The facility also began on-site recycling of solvents (not source reduction) collected from its air pollution control equipment. To reduce facility trash waste, the facility began buying more raw materials in bags instead of fiber drums. Data from the facility indicates that there were significant decreases in the amount of hazardous waste shipped (manifested) off the site when comparing 1990 with 1994.

North American Chemical Company
Trona**SIC code 2819**

This facility includes three beneficiation operations which purify dissolved chemicals that are extracted from brines located below the surface of Searles Lake, a dry lake located in an unincorporated area of San Bernardino County. Different areas of the lake's subsurface contain different concentrations of the various substances processed in the operations. The extracted inorganic compounds of sodium, potassium, and boron are refined and sold as borax, sodium sulfate, soda ash, and boric acid. Annual production is approximately two million tons.

Process

To remove boron for boric acid production, brine pumped from the dry lake is mixed with a proprietary product and kerosene which serves as an extractant. The process creates a byproduct substance is referred to as Crud. Crud is pumped to a heating chamber where it undergoes dechlorination. During dechlorination, kerosene is removed through distillation and then returned to the liquid-liquid extraction (LLX) process. In the LLX process, chemicals are added to the extracted material to isolate the boric acid, and moisture is removed using a centrifuge. The dry material is then screened to achieve particle size homogeneity. To extract soda ash, brines undergo a series of pH and temperature treatments. The brines are then put in solution and recrystallized. The material is then screened and milled. Over one million pounds of soda ash were produced in 1995.

1994 Waste Stream Generation

The Plan listed three major routine waste streams totaling 1059 tons. One waste stream was spent lube oil (CWC 223- waste oil and mixed oil; 114 tons). A portion of this waste was contaminated with ammonia and generated from a large compressor unit; the remaining portion of this waste stream was produced from more than 100 units of small equipment. A second waste stream was oil/water skimmed from the onsite settling tank; this waste also included sludge bottoms from a settling tank (CWC 221 & 222 - waste oil; 492 tons). Some of the waste oil quantity included oil from vehicle crankcases which is an excluded waste under SB 14. A third waste stream was waste fuel oil which is generated as the non aqueous material which remains after kerosene is distilled off the Crud (described in process description); CWC 214- unspecified solvents; 452 tons. The Plan did not account for all routine waste streams because it did not discuss (CWC 352 - other organic solids) although DTSC manifest records indicated that 79 tons of this waste category were shipped from the site.

Source Reduction

Source reduction actions listed in the Plan included segregating waste automotive oil from other waste oil; a step estimated to reduce waste subject to SB 14 by 16.5 tons, and installing additional in-line oil filtration units on two centrifuges to extend oil drain intervals. This measure was estimated to cost \$6,000 with a two year payback. Another chosen measure was to replace a compressor oil that was subject to ammonia contamination with a specialized refrigeration oil not subject to ammonia contamination. This latter measure dealt with a problem that occurred in 1994 in which 60 tons of waste oil was generated when the oil was contaminated with ammonia. A last chosen measure was to institute employee training to eliminate an operational problem that resulted in the generation of approximately 16 tons of oil contaminated with halogens.

Past Source Reduction

Prior to 1990, the plant installed equipment that made the in-process recycling of kerosene (mentioned in the above process description) possible. Spent lube oil quantities were reduced by approximately 50 percent comparing 1990 to 1994 by a combination of installing in-line oil filtration units on equipment with large oil reservoirs and replacing 10 filter vacuum pumps with steam ejectors. The Report lists 1990 waste generation as 524 tons and 1994 waste generation as 1059 tons; however, this apparent increase is misleading. In 1990, fuel-oil waste (452 tons in 1994) was shipped offsite as a marine fuel rather than being manifested and counted in 1990 as a hazardous waste.

Notes: * The Management Performance Report noted that the skimmer plant will be shut down during 1996, and that this will affect waste generation of skimmer oil, but specific details are unknown.

Perkins-Elmer-Applied Biosystems Division **Foster City**

SIC 3826 & 2869

This firm makes and assembles automated analytical instruments and also manufactures liquid and powder chemical reagents including amidites, phosphoramidites, and phosphites. Amidites are protected and activated aminoacids. Phosphoramidites are used on DNA/RNA Synthesizers and Oligosynthesizers. Chemical reagents are used in the synthesis, purification and analysis of biological molecules. These instruments are used in the lab for chemical testing and measurement.

The Plan lists three divisions in the facility: instruments, chemical reagents, and research & development. Operations include assembly, and manufacturing. The site's manufacturing operations include high volume and low volume chemical aminoacid synthesis processes. There is also a section of the plant dedicated to process development. Each sub-plant contains its own laboratories.

Process

Liquid or gas phase reactions occur in large glass-lined vessels using substances which include solvents, and trichlorides or dichloromethane, and other agents. After initial reactions are completed, process

mixtures may be dried, filtered and/or washed with a solution. Solvents and impurities are removed from process mixtures using a continuous countercurrent extraction column. Products are further purified using columns or a thin film evaporator. In addition to manufacturing, facility activities that generate waste streams include glassware and metal cleaning operations, quality control, laboratory research and development, instrument assembly, and packaging activities.

1994 Waste Stream Generation

The site's largest routine waste stream category was CWC 741 - liquids with halogenated organic compounds; 96 tons. Ninety percent of this waste type was generated as byproduct from chemical synthesis processes. Smaller quantities of this waste type, some of which included spent methylene chloride were generated in the chemical synthesis laboratory, quality control operations, instrument assembly and bottle cleaning operations. The second largest waste stream category was CWC 134 - aqueous solution with organic residues ; 73 tons. Most of this waste stream type which consisted of water with trace amounts of methylene chloride was generated from bottle/glassware cleaning activities. Other wastes included CWC 352- other organic solids which consisted of contaminated gloves, wipes, chromatographic supports, drying agents, plasticware, and glassware. A final routine waste type was CWC 791 - halogenated and nonhalogenated organic acid wastes generated from conducting biotechnological chemical procedures.

Source Reduction

The most significant source reduction measure implemented at this facility was to institute alternative glassware and large reactor vessel clean out methods. These alternative methods include using spray cleaning wands and vaporizing temperatures in conjunction with line condensers to reflux the cleaning solution which contains detergent and solvent. Annual savings from reduced solvent purchase, and reduced waste disposal and labor costs were estimated to be \$59,000. A pyrolysis cleaning system for small glass vessels which uses a small oven is currently under pre-purchase evaluation. Other measures included replacing solvent based (stoddard solvent) metals degreasing and cleaning bath systems with aqueous cleaning systems that will use Simple Green[®]. The facility also began researching the possibilities for replacing or eliminating methylene chloride use as a chemical reagent. Methylene chloride use has successfully been eliminated in the phosphoramidite purification process. This reduces CWC 741 waste generation by approximately 4 tons per year. The facility also investigated using an inventory control system based on bar code tracking in conjunction with a procurement database, but determined that costs outweighed potential benefits. As an alternative for reducing excess or expired chemical reagent waste, the facility has implemented a Just in Time Manufacturing procurement system.

A longer term source reduction strategy being investigated at Perkins-Elmer Applied Biosystems Division is to develop catalytic solid phase reaction systems to replace liquid phase systems which use solvents as carriers in chemical synthesis reactions. In the solvent based systems products are extracted from solvent solutions in the product purification phases. The spent solutions are wastes. Catalytic

solid phase reaction systems use stoichiometric quantities of raw materials and eliminate solvents waste generation. The Plan mentions that more detailed economic evaluation of this alternative technology will be conducted in 1998.

Past Source Reduction

The Management Performance Report mentions that in the past solvent-water waste was reduced by eliminating chemical and flow testing of instruments, dedicating equipment for manufacturing specific products, reintroducing solvent used in cooling baths and condensers back in to the processes, using higher quality raw materials, and replacing hexane and phosphorous trichloride with heptane. In addition, the facility began recirculating chilled glycol solutions in reactor vessel cooling jackets to replace cooling equipment that required routine draining and refilling. Waste stream generation increases comparing 1990 with 1994 were attributed to increased production although production increases were not quantified.

Pharmavite Corporation San Fernando

SIC code 2834

Pharmavite manufactures, packages and distributes vitamins and food supplements and coated and uncoated tablet or gelatin capsule pharmaceutical products.

Process

Powered raw materials are blended with lubricants and fillers in large enclosed mixing vessels on a batch production basis. The dry blended mixture is then fed continuously to rotary tableting die press. Some products are then spray coated with an aqueous coating in a dryer tumbler unit. Coated tablets are collected in bulk containers for storage and later transferred for packaging. Encapsulated products are formulated using mixed and blended liquid raw materials.

1994 Waste Stream Generation

The largest waste category (either CWC 181-other organic solids or 591- baghouse waste; 177 tons) consisted of product dust, and off specification or expired product. Another significant waste was mineral oil (CWC 223- unspecified oil containing waste; 39 tons). Sources of waste generation included customers returns of unsellable, expired, or improperly packaged product, and dust generated from mixing, blending and conveying operations in the plant. Mineral oil is used to lubricate the capsules which are filled by injection, and also the equipment used for encapsulation. The primary sources of waste mineral oil waste is excess oil which drips into collection pans in the encapsulation process. Some of the product dust is nonhazardous waste, but occasionally it becomes hazardous when copper or zinc levels exceed hazardous classification thresholds; however, continuous monitoring was considered too

expensive and all dust is routinely managed as hazardous waste. Another waste stream, CWC 134 - aqueous solution with total organic residues < 10 percent; 22 tons, was generated from washing process equipment.

Source Reduction

No chosen measures were listed in the Plan. Discussions with facility personnel indicated that hazardous and non hazardous waste is segregated by visual inspection and the facility is examining the feasibility of using dedicated equipment for product lines, and collecting mineral oil differently to enable in-process reuse. Since the Plan was written, the facility began purchasing some materials that can be directly compressed because the materials have already been mixed and blended. This practice should reduce waste product dust. In mid 1996, the facility implemented encapsulation machinery design changes such that the requirement for mineral oil in the encapsulation process was reduced by 33 percent. As a result, waste mineral oil generation dropped from 10,000 gallons in 1996 to 5300 gallons in 1997 despite a 29 percent increase in total capsules produced (1996 vs. 1997).

Past Source Reduction

This facility reports that it eliminated the use of 1,1,1, trichloroethane and replaced it with cleaning procedures that use brushes and no solvents.

Proctor and Gamble Sacramento

SIC code 2869

This facility manufactures oleochemicals from raw coconut and palm kernel oil feedstocks. Specific products are fatty alcohols, methyl ester, and, to a limited degree excess methanol which is recovered and distilled on-site.

Process

Methanol is chemically combined with sodium hydroxide to produce sodium methylate. In large vessels, sodium methylate chemically reacts with refined coconut oil to produce methyl ester. When coconut oil is refined, triglycerides are split into two layers via phase separation. Purified glycerin is extracted and methanol is distilled from the water-methanol layer for on-site reuse. Insoluble methyl esters are fractionalized from the remaining layer by temperature controlled splitting within a distillation column. The light cuts are acidified and further split into fatty acids and methanol. Middle and heavy cuts of methyl ester are hydrogenated in a reaction with high pressure hydrogen after the methyl ester is combined with a copper chromate catalyst to produce fatty alcohol.

1994 Waste Stream Generation

One waste stream was listed for source reduction evaluation; spent catalyst (CWC 162- other spent

catalyst; 492 tons). The catalyst is slurried in alcohol to assist the hydrogenation reaction of fatty esters to alcohol. Spent catalyst waste is then filtered from the product and is sent off site for landfill disposal. A portion of this waste is sent to a facility that reclaims copper from the waste before it is disposed. Non routine waste produced from a partial plant shutdown and cleanup operations included 600 tons of contaminated soils and 258 tons of asbestos. Since 1990, three operations have been discontinued: synthetic granule production, and the production of two commercial products (Comet[®], and Downy[®]), as well as the plant's main laboratory.

Source Reduction

According to the Plan, no source reduction measures could be identified for detailed evaluation and none were chosen for implementation. An in-process catalyst recycling process developed by another P&G facility was considered but corporate experience with this technology proved it to be unreliable. The Plan also mentions that in mid-1996 it should be able to convert to using a superior grade of copper chromite catalyst which will result in using less catalyst and may affect waste generation rates although the anticipated reduction was not estimated.

Past Source Reduction

No specific measures were described. The Report notes that former changes in process parameters lead to a reduction in the number of times the system needed to be purged.

Rhodia (formerly Rhone-Poulenc) Martinez

SIC code 2819

This facility produces sulfuric acid and oleum from the regeneration of spent sulfuric acid received from refineries and other industrial generators. Sulfuric acid, the largest volume chemical produced in the United States, is used as a component in end use products which include fertilizers, lead acid batteries, film, dyes, and pigments. It is also used by the electronic components manufacturing industry in cleaning and stripping applications. The primary customers for this plant's sulfuric acid are petroleum refineries which use it as a process catalyst. This facility also produces zinc sulfate fertilizer by extracting zinc from the site's groundwater. The facility also produces an ammonium bisulfite fertilizer which is a solution from the site's air pollution control scrubber.

Process

Sulfuric acid and oleum are produced by first injecting spent sulfuric acid and molten sulfur into a high temperature industrial furnace. The spent sulfuric acid is decomposed, and sulfur is combusted to form a sulfur dioxide rich gas. The sulfur dioxide gas is then cooled by passing it through a waste heat boiler. The gas then enters a quench tower followed by an electrostatic precipitator that removes particulate contaminants. The process gas is then cooled and further cleaned in gas coolers and a second stage electrostatic precipitator. It is then dried in a drying tower. Following drying, a centrifugal compressor forces the gas through a converter containing a vanadium catalyst to convert sulfur dioxide to sulfur

trioxide. The sulfur trioxide is then combined with water to produce sulfuric acid in an absorbing tower, and further super saturates a continuing sulfuric acid sidestream to produce oleum in the oleum tower. The gas containing unconverted sulfur dioxide is cleaned in an ammonia scrubber/mist eliminator before discharge to the atmosphere.

1994 Waste Stream Generation

Acidic wastewater (CWC 791- liquids with pH 2; 394 tons) was the largest of three major routinely generated waste streams produced at the site in 1994 and represented 91 percent of the total routine waste. This 10 percent sulfuric acid wastewater is produced from the gas conditioning steps, which include gas quenching, gas cooling and particulate removal using electrostatic precipitators.

A small amount of this wastewater was also generated during the decomposition of ammonium bisulfite solution when the solution is reused as a process input. The solution comes from the site's air pollution control scrubber. Ammonium bisulfite solution is not typically used as a process input material. Most solution is sold as a fertilizer product.

After acidic wastewater is treated by adjusting the pH it is discharged to the Carquinez Strait under a National Pollutant Discharge Elimination System permit. The site's other two routine waste streams included boiler fly ash (CWC 571- fly ash, bottom ash), and drying tower sludge (CWC 181 - other inorganic solid waste). The fly ash is generated from the periodic removal of solids and ash which build up in the furnace. It is hazardous waste because of its chromium content. Drying tower clean outs, which are conducted to maintain an adequate gas flow rates, generate a sludge which is filter pressed to remove water. This sludge is hazardous due to its mercury content. These two waste streams are sent offsite for stabilization and land disposal.

Source Reduction

Improving communication with the facility's ammonium bisulfite purchaser to better coordinate pickup scheduling was a chosen option to reduce the acidic wastewater stream. Ammonium bisulfite solution generated from the site's air pollution control scrubber is normally sold as a fertilizer product. However, occasional increases in sulfuric acid production resulted in excess ammonium bisulfite solution that could not be taken by the fertilizer purchaser without advance notice. In those instances, the material had to be reintroduced into the beginning of the process to recover its sulfur value. The reuse of this material in the production process increased acidic wastewater generation rates. Annual cost savings from diverting all of this ammonium bisulfate solution as a fertilizer product were estimated to be \$10,000.

Past Source Reduction

The Management Performance Report listed previous source reduction measures to reduce acidic waste water which included using quench tower generated acid as a raw material, incorporating precipitator drip as makeup solution in the absorbing tower, using cooler drip as quench material in the ammonia

scrubber, and also using this material for cooling tower water pH control. The 1990 baseline year acidic wastewater quantity of 477 tons was reduced to 392 tons in 1994. To reduce the fly ash waste stream CWC 571, the Plan discusses segregating boiler refractory (non-hazardous brick material) from the waste stream. The hazardous fly ash portion of the waste stream is a powdery material that is removed using a vacuum pump during furnace and boiler clean outs. This measure implemented in 1994 reduced CWC 571 waste from 57 tons in 1990 to 34 tons in 1994.

This site was contaminated through past onsite disposal practices of the Mountain Copper Company, which operated a copper smelting plant. During the 1960 s large piles of residual cinder and sludge containing wastes were removed by Stauffer Chemical Company during the construction of the existing sulfuric acid plant. However, residual material which remained as much as 40 feet below grade began generating an iron and zinc leachate during rainfall events. This resulted in iron and zinc groundwater contamination. The Regional Water Quality Control Board required that the contaminated groundwater be treated prior to discharge to the Carquinez Strait. In 1993, Rhone-Poulenc spent approximately \$350,000 to dispose of more than 1000 tons of hazardous filter cake generated from the treatment operation. During 1994, the company modified the wastewater treatment process such that iron and zinc are separately precipitated out of the water by altering water pH conditions in a two stage system. The iron filter cake produced from this modified system is now classified as non hazardous waste, and the zinc filter cake produced from the system is used to make fertilizer. This process modification reduced solid hazardous waste generation by 88 percent (from 1350 tons to 159 tons) and waste disposal costs by approximately \$250,000 when comparing 1993 to 1994.

Roche Bioscience - Syntex USA Division
Palo Alto**SIC code 2834**

This facility manufactured drug products including Cardene[®], Nasalide[®], Synnarel[®], Synovex[®], and Ticlid[®] which are sold as either tablets, ointments or creams. However, research and development of new pharmaceutical products is the primary focus of the site s activities. The Plan notes that the Roche Holding Limited plans to curtail, and perhaps eliminate bulk pharmaceuticals production at this facility in the Fall of 1996.

Process

The process is not specifically described in the source reduction Plan. Raw materials which include drug substances and excipients are mixed/blended or reacted in vessels. Process streams typically contain solvents which function as carriers and intermediate products are filtered to remove impurities. Product streams are dried, granulized and then incorporated into the formulated mixtures are then formed into tableted or capsulized products. Tablets are typically coated with a solvent based solution. In the facility s chemical pilot plant, small batch products are also produced using similar processes that are described above except that substances of interest are extracted via chromatography. Small batch pilot products are filtered or separated in a centrifuge and then dried.

1994 Waste Stream Generation

The site's largest waste category, CWC 214- unspecified solvents; 236 tons, appears to have production processes as the largest source of generation followed by formulation and packaging line equipment cleaning. Solvent waste is also generated from using High Pressure Liquid Chromatography (HPLC) instruments in gradient and isocratic analysis research systems within various laboratories at the site. Acidic rinse wastewater (CWC 791 - liquids with $\text{pH} \leq 2$; 83 tons) is generated from cleaning production equipment and animal cages. The sources generating CWC 311- pharmaceutical waste; 135 tons, included off specification solid product, used personal protective equipment, trash and debris, and lab material waste. Washing glassware also generated a small amount of solvent waste.

Routine waste generation increased 42 percent when comparing 1990 to 1994. In the past, some solvents were segregated and sent off site for energy recovery. All solvent wastes are now incinerated off site. Waste increases were attributed to slightly increased production, reclassification of waste streams, increased research and development activities, and implementing semi-annual lab cleanups.

Source Reduction

Using modified HPLC instruments was listed as a process modification to reduce solvent waste generation. This involved adding a device to each instrument used in isocratic analysis systems to divert uncontaminated solvent back through the instrument and thus reduce or eliminate disposal of excess solvent. This \$2,000 solvent recycler was deemed feasible in a portion of the HPLC instruments used at the site for research applications; particularly in the quality control laboratory. In isocratic analysis, mixes of solvents are run through the instruments in the same concentrations at discrete intervals to separate the solvent from the compound of interest, and the chromatography units can be set up to run continuously. An air bubble goes through the column (tube) followed by the samples. The bubbles divide the sample points. When there are spikes in the analysis that indicate detection of the compound of interest a valve is triggered which diverts contaminated material to a waste disposal container. It may take 24 hours to analyze a gallon of mixture.

Waste tracking by each facility department was listed as an administrative measure to study because waste accounting practices aggregated waste costs facility wide. Other measures listed were an employee awards program and training. Training protocols developed at the site seek to raise waste consciousness by promoting the use of excess solvents by making the material available between laboratories and researchers. Solvents typically have shelf lives of one year, and personnel rotations often involve clean outs of lab areas which can generate sizeable quantities of chemical wastes. When these events now occur, a list of excess chemicals and materials is produced and distributed to other personnel to see who can use the excess materials.

Past Source Reduction

A waste minimization training module was developed and a surplus chemical inventory database was developed to help reduce ordering chemicals that were already in stock. In addition, chemical ordering policies were modified to encourage procuring minimum quantities needed.

Schumacher of Air Products and Chemicals
Carlsbad

SIC code 2869

This facility produces highly purified liquid and solid chemicals primarily for semiconductor and circuit board manufacturers. Major product lines include tetraethylorthosilicate, trans 1,2-dichloroethylene, 1,1,1, trichloroethane (TCA), and phosphorous oxychloride. Since 1994, production of TCA has decreased while trans production has increased due to its use as a substitute for TCA.

Process

Raw materials are received in 55 gallon drums, checked for quality control and then pumped into a reboiler or pot, a system made inert by the introduction of nitrogen, in which material is heated to boiling temperature and the resulting vapor passes through a distillation column containing disks. Condensed liquids cascade from one disk to another as desired material is removed at separation devices (splitters). Light materials (prefractions) and heavy materials (heavies) are removed as impurities. The final products, condensed liquids are then packaged in specialized glass or stainless steel containers that are distributed and returned to Schumacher for reuse.

1994 Waste Stream Generation

Most of the waste generated was described as off-specification product called heels and prefraction rejects generated as byproducts in the distillation process. For each major product line this material was generated, although waste code designations of the wastes vary. Included in these waste streams was residual material in containers which customers return to Schumacher for refilling. Waste codes were combined to categorize waste; however CWC 741 - liquids with halogenated organic compounds \geq 1000 Mg/L was the largest waste category generated (25 tons). Other waste streams included 5.5 tons of spent cleaning agents consisting of various solvents such as acetone and isopropyl alcohol which contain deionized water, and CWC 512 - empty containers (4.0 tons). The Management Performance Report shows that waste generation increased from eight tons in 1990 to 45 tons in 1994. The most important factor causing increased waste generation was increased production.

Source Reduction

Chosen measures included segregating waste from recoverable material, using the substances in rejected containers as raw material feedstock, formalizing procedures on how to deal with spent materials including using computers to track spent material, and segregating reusable containers for reuse from containers that must be disposed.

Past Source Reduction

No retrospective source reduction measures were discussed in the Management Performance Report; however, the site appears not to have been subject to SB 14 in 1990. In 1995, the facility investigated onsite recycling of acetone/IPA and buying raw materials in bulk quantities. Although details were not provided, these options were determined to be economically infeasible.

Star Pacific Union City

SIC codes 2841

Star Pacific manufactures approximately 40 brands of household powdered detergents. Some off specification material is wholesaled to bulk dealers.

Process

Liquid raw materials such as sodium hydroxide, silicates, alcohol ethers, and xylene sulfonate are mixed with dry materials (typically sodium carbonates and/or sodium sulfates), oils and conditioners in a vessel called a crutcher to form a homogeneous slurry. The slurry is initially conditioned in a device called a Rietz mill. Following conditioning, the slurry is pumped to a holding tank. Just prior to being used in the next process step the mixture is agitated. The slurry is then pumped to the top of a spray tower and injected through high pressure nozzles. The injection atomizes the mixture sending it cascading down the tower. As the spray cascades down the tower it contacts a countercurrent hot air stream. This action removes moisture from the process stream. The moisture laden air expels to the atmosphere after going through cyclones and a wet scrubber. At the bottom of the tower, the detergent mixture is collected. This material is then conveyed to an airlift which conditions the granualized powder. The material is then screened. After this step, fragrance and color are added to the powder mixture. The material then screened to final product size. Enzymes are added just before packaging,.

1994 Waste Stream Generation

All of the waste identified in the source reduction Plan was classified as CWC 561 - detergent and soap ; 86 tons. Waste sources included off-sized material collected in the drying tower, line and nozzle clean out material from production switch over operations, tailings (densely packed detergent) from off specification production and clean outs of the spray tower and cyclones. Recycle or rework material is collected from some of these sources and stored in super sacks. Small amounts of this reworkable material are added in other batches. Excess recycle was handled as waste. In addition, some material collected from housekeeping activities is too contaminated to rework. Some waste was generated when it falls off the conveyor that transfers the material from the tower to the airlift. Some portion is swept up for rework while some material is washed off conveyors and ends up in wastewater discharged to the sewer. Sometimes the wastewater containing detergent was used to constitute a solution for make up water in another batch.

Source Reduction

A Hockmeyer unit, a device typically used to mix paint ingredients, was installed in 1995. This unit processes tailings material so that it can be used as re-mix. Less waste is generated as a result of this in-process recycling; although reduction quantity was not indicated. The report claims that waste generation normalized to raw material usage decreased from 0.38% in 1994 to 0.27% in 1995. Reducing the variety of products made, better scheduling of compatible batches, and using the Hockmeyer unit all helped achieve this result. The Plan notes the future intention to evaluate the frequency and timing of replacing the nozzles used in the tower. The longer a nozzle is used, the more out of specification material is produced. Increased replacement frequency may help reduce off specification product waste.

Past Source Reduction

No previous source reduction measures were discussed in the second document submission which included the Management Performance Report. Waste is collected in gondolas and then shipped for landfill disposal. Each gondola box of waste costs the company a \$7,600 disposal fee. The facility's goal is to reduce waste to below the 12,000 kilogram SB 14 threshold.

Stepan Company Anaheim

SIC code 2843

This facility manufactures surfactants used in shampoos, dishwashing soaps, and laundry detergents. This facility also batch produces alkanolamide products which are used in shampoos and dishwashing soaps as foam boosters and thickening agents.

Process

Organic feedstock materials such as lauryl alcohols, alpha olefins or alkyl benzene are reacted in a sulfonation reactor vessel with sulfur trioxide gas to produce an acid substance which can be sold as a liquid product, or it can be neutralized with sodium hydroxide or ammonium hydroxide to form a salt product. The above described process is called continuous falling film sulfonation. The sulfur trioxide used in the process is made at the site by burning molten sulfur to produce sulfur dioxide gas which is converted to sulfur trioxide.

To batch produce alkanolamide products, methyl ester or cochin oil is reacted in a vessel with diethanolamine and a methylate catalyst. The process streams are then blended or compounded to achieve properties specified by the customer.

1994 Waste Stream Generation

The largest waste stream produced was contaminated methanol (CWC 214 - unspecified solvents; 66 tons), a reaction byproduct vapor removed during vacuum stripping which is used to purify methyl ester amide products (alkanolamides). The vapor condenses to a liquid waste which is managed by offsite incineration. The site's other major waste stream, demister elements (CWC 352 - other organic solids; 4.4 tons), were generated in the sulfonation process. Demister elements are fiberglass elements packed in steel cages that filter process air to remove organic matter, sulfur dioxide, and sulfuric acid impurities.

Source Reduction

To reduce demister elements waste the facility incorporated new Monsanto sock style elements upstream of 50 percent of the plant's demister elements to extend the useful life of the demister elements (1995). The Plan mentions an operational improvement as a measure to reduce waste generation associated with process equipment start-ups and shutdowns by optimizing the production schedule. The Plan and Management Performance Report both mention the curtailment of facility plans to improve the quality of recovered methanol by installing a new vacuum pump.

Past Source Reduction

One of the primary source reduction measures listed in the 1995 Plan was already implemented in 1991. This measure involved increasing the operating pressure in the reaction vessels in conjunction with the installation of a new vessel system. This measure reduced waste demister elements by 80 percent when comparing 1990 to 1994. As an alternative to installing a new vacuum pump for methanol recovery, the existing recovery system was rebuilt between 1990 and 1994. This rebuilt system recovers methanol which now can be sold as a product. As a result, this improvement almost entirely eliminated discharge of methanol-water waste to the POTW (23 tons in 1990).

Teledyne Ryan Aeronautical Hollister

SIC Code 2892 & 3489

This facility intermittently manufactures explosive and pyrotechnic compounds, and also nitrogen based chemicals that are used by agricultural, and pharmaceutical companies. The site's primarily manufacturing activities include the design and fabrication of equipment, and electronic and explosive systems, used in the aerospace, automotive safety, and petroleum industries.

Process (*chemical substances only*)

The chemical 2,4,6 trinitrotoluene is dissolved in a minimum amount of methanol to form a saturated solution. Sodium hypochlorite solution is then added to the solution to begin an exothermic reaction in which temperature is controlled via the rate at which the solution is added. When the reaction is

complete, an intermediate material (hexanitrobibenzyl) is isolated by vacuum filtration. This intermediate material is then washed and vacuum dried. After drying, the material is used to produce 2,2',4,4',6,6'-hexanitrostilbene-II. This facility also creates rapid deflagrating explosive and pyrotechnic mixtures by mixing explosive fuels and oxidizers in a wet blending process which uses heptane as a non-solvent suspension agent. The resulting material is isolated by vacuum filtration and then dried.

1994 Waste Stream Generation

Four major routinely generated waste streams are listed in the 1995 Plan. Methanol, water, and hexanitrobibenzyl by-products constitute the largest waste stream categorized as CWC 352- other organic solids; 5.7 tons. The bulk of this waste stream is produced in the first of three discrete reaction steps which produce 2,2',4,4',6,6'-hexanitrostilbene-II. The other major wastes included ordnance waste (CWC 352 - other organic solids; 4.3 tons), Cindol, a mineral oil/water waste (CWC 343 - unspecified organic liquid mixture; 3.4 tons), and heptane (CWC 213 - hydrocarbon solvents; 1.1 tons). Ordnance wastes were generated from off specification production of linear flexible tubes which contain explosives, cuttings from the tube ends and general scrap produced in manufacturing.

Source Reduction

To reduce methanol, water, and hexanitrobibenzyl by-products waste the concentration of sodium hypochlorite solution was increased by a factor of two. This step was estimated to reduce waste by 6,500 lbs annually given 1994 production rates. To reduce ordnance waste, the company developed a new rapid deflagrating cord product (a tube shaped forged item that initiates deployment of passenger side automobile air bags) which uses tin as a sheathing material rather than lead. By the year 2000, the company estimates that it will have completely converted the product line to the new product which will consist of 99.9 percent tin. To make conversion to the tin sheath product possible, the explosive powder used in the sheath had to be reformulated. Another measure used to reduce ordnance waste involved incorporating statistical control monitoring at work stations to predict the expected lifetimes of pneumatic vibrators that are used to help load and to insure that the correct amount of powder is packed into the tubes. Worn out vibrators create faulty product which is disposed as hazardous waste.

Past Source Reduction

Past source reduction measures at the facility included installing in-line filters to extend the change out intervals of Cindol (mineral oil) which functions as a lubricant and a cooling agent in the site's tube producing metal forging (swaging) operation. The facility also eliminated the use of heptane which functioned as a milling media in the milling operation by purchasing new milling equipment, and optimized the amount of methanol used in the reaction to eliminate excess methanol waste. Comparing 1990 with 1994, waste generated per unit of product decreased for each of the site's major waste streams from 12 percent up to 84 percent.

US Borax and Chemical Company Wilmington

SIC Code 2819

This facility manufactures granular fertilizers and detergents, zinc borate chemical intermediates, sodium metaborate, boric acid, and potassium borates. Chemical products made at this facility were grouped into four categories. These categories included specialty products, zinc borate, spray dried products, and granular fertilizers. US Borax's products are used in a variety of industries including pharmaceuticals, photographic processing, coatings manufacturing and agricultural production.

Process

To produce specialty products, raw materials are dissolved in a steam-heated solution, mixtures are filtered and then cooled. The cooled material crystallizes and contaminants are separated from the crystallized material by centrifugation. Then the mix is screened to ensure uniform particle sizes. Screened material is then dried. Zinc borate is produced by reacting mother liquor, boric acid, and zinc oxide. The slurry from this reaction is centrifuged, dried, and collected in a dust collector. The dried product is then screened and packaged. Spray dried products are produced by preparing liquors in a mix tank, filtering, and then spray drying. These products are also screened prior to packaging. Granular fertilizers are made by spraying raw material dust with a sulfuric acid solution. The sprayed material passes through a pin mill that agglomerates the particles. Agglomerated material is conditioned in a drum and then dried. The last step before packaging is to pass the material across two vibrating screens to achieve uniform particle size. Oversized material is ground and recycled back into the process.

1994 Waste Stream Generation

The largest waste code type generated was CWC 181 - other inorganic solid waste ; 69 tons. This waste included lead paint, zinc borate residue, and caustic tank bottoms. Much of this material was generated as non routine waste from a facility renovation and cleanup campaign during 1993-1994. Waste zinc borate residue was listed as the only routine major waste stream with a total of 15 tons generated. Sources for this waste included residue removed from heat exchanger tubes, baffles, the interior of zinc borate reactors, and dust collector socks. The Management Performance Report notes that other wastes are intermittently generated at the site in small quantities, and lists the quantities of these waste generated for the years 1990 to 1994. These wastes included oil water sump sludge and waste oil from draining gear boxes (CWC 221), floor sweeping debris, empty zinc oxide bags (CWC 181). Other wastes included off specification contaminated product (CWC 181), mud waste (CWC 134), and a secondary nonsource waste from waste treatment (CWC 241) that contained process liquors, zinc, flocculent, and arsenic, and water.

Source Reduction

A primary contributor to waste zinc borate was used dust collector socks. When any one of these socks leak the traditional practice was to replace all 25 of the socks. The primary alternative listed to reduce

this waste was to research using alternative dust collector socks and to combine this approach with altering the amount of air used to move material into the socks to extend sock life. Rejected measures included using leak detection equipment to identify which socks needed repair or replacement and repairing individual socks as necessary. It was unclear why each of these measures were considered infeasible. The second chosen source reduction measure was improved use of statistical process control (SPC) methods to reduce waste zinc borate generated from cleaning out reactor tanks and other process equipment. No details were provided regarding how the use of SPC might be improved. The Plan indicated that implementation of chosen source reduction measures was ongoing.

Past Source Reduction

Descriptions of past source reduction measures and their impact were very non specific. It appears that waste generation per pound of product decreased comparing 1990 to 1994 because of increased in-process reject material recycling.

Zeneca Agricultural Products Richmond

SIC code 8731 and 2879

Zeneca Agricultural Products Western Research Center is a 30 acre facility that has been historically focused on the research and development of new agricultural chemical products. The site's Environmental Health and Safety manager noted that the agricultural products industry is moving towards increased study and application of biological, or biochemical products as opposed to pure chemical products for managing insects, weeds and crop diseases. In 1994, the process technology department consisted of laboratories, and a pilot plant which produced batch lots of chemical compounds for the formulations department, and small amounts of commercial products. Activities in this department, which began downsizing after 1994, produced over 40 percent of total routine hazardous waste generated at the facility. As of 1997, the process technology department functions have been moved to an out-of-state facility. Other facility departments which generate hazardous wastes include chemistry, environmental sciences, product development (including formulations), research services, and biological research and development.

Process

Batch lot production of chemical compounds involved charging vessels with solvents, additives and chemical ingredients to initiate reactions which produce chemical compounds potentially useful in agricultural applications. These compounds are studied for their metabolic properties, distinct chemical identities, the regulatory implications associated with their use, and appropriate formulations. Prior to field testing, the chemical compound is sent to the site's formulations group. Using surfactants, solvents, or diluent/carriers, formulations are prepared such as emulsifiable concentrates, granulars, water-based flowables, or micro encapsulations.

1994 Waste Stream Generation

Department of Toxic Substances Control manifest database records indicate that 172 tons of hazardous waste were shipped from the site in the reporting year. The 1995 Plan and Report lists five major routine waste streams. The two largest were pilot plant brine waste (CWC 123 - unspecified alkaline solution; 35 tons), a sodium chloride liquid waste generated from production and from spent air pollution control scrubber solutions, and laboratory trash (CWC 551- laboratory waste chemicals; 33 tons) which consists of used personal protection equipment, vials, pipettes, used samples, and general laboratory materials. Another waste was lab packs containing flammable liquids (CWC 551- laboratory waste chemicals; 13 tons). The last major waste stream was solvents (CWC 741 - liquids with halogenated compounds \geq 1000 Mg/L; 25 tons) which were excess solvent inventory, and contaminated solvents generated from organic compound extraction and chromatographic analysis, other forms of testing, sampling and laboratory activities such as mass spectrometry.

Source Reduction

The Plan lists the following source reduction measures: using supercritical fluid extraction equipment that uses carbon dioxide as an alternative extraction medium to chlorinated solvents, coupled with the purchase of a mass selective detector; a measure not implemented for technical reasons, replacing cleanup columns with cartridge-type extractors, and using a bio-imaging analyzer which uses less solvent. None of these measures were implemented for technical or economic reasons. Measures that were implemented included developing analytical methods based on using small bore high pressure liquid chromatography instruments, bar coding the working chemical inventory, miniaturizing analytical methods to reduce chemical use, and designing spray apparatus in greenhouses to minimize over spray.

V. Source Reduction Measures^o

This chapter provides a list of ideas for consideration by chemicals and allied products manufacturing facilities when identifying possible or potential source reduction options. This list is organized by source reduction category. The adjacent number(s) identifies the specific company or companies that reported implementing the measure according to their source reduction plans or management performance reports (refer to acknowledgements on for individual company number assignments on page ii). Other ideas were gleaned from reviewing industry trade journals.

Administrative

Identify critical equipment and establish performance indicators

Restructure relationships with chemical suppliers to reduce excess inventory of chemicals; refocus relationships towards buying a service rather than buying chemicals. The benefits of improving chemical management systems can include enhanced production quality and efficiency by spurring innovation for process improvements, reduced costs for storage, purchase and disposal of chemicals, improved plant safety, and reduced environmental impacts. For more information contact: Jennifer Boss, Chemical Strategies Partnership, 423 Washington Street, 4th floor, San Francisco 94111 (415) 421-3405 for more information. Also see Vol. VIII, No.8 issue of Business and the Environment^o.

Bar code label waste containers for waste tracking to allocate waste charges to individual facility operations that generate the waste, (5)

Bar code label chemical inventory and create database to improve inventory control (5)(8)

Waste diversion- donate expired self-life usable chemical supplies to educational institutions (6)

Review and produce written cleaning and other procedures to, for example, specify number and quantity of rinses, quantity of rinse solutions, and flowrates used to dispense chemicals (9)

Process or equipment related

Investigate using computer control automation to perform practices and processes more quickly and consistently. For example, examine existing auxiliary control equipment when upgrading production systems to increase capacity or to improve raw material yields. Look for opportunities to incorporate programmable logic controllers, and replace individual raw material volumetric flow meters with dual mass flowmeters to reduce the need to calibrate equipment during startups and shutdowns. (see Chemical Processing 9/95, pg 37-39) (2)

To reduce off specification product, investigate opportunities for improved temperature control such as using enclosed systems, and channeling byproduct heat or cooling to facilitate improved temperature control.

Use small bore column high pressure liquid chromatography instruments in pharmaceutical or biotechnology research (5)

Use solvent recyclers on high pressure liquid chromatography instruments for isocratic based pharmaceutical or biotechnology research (5) (33)

Use pressure transmitters that maximize the intervals between needed calibrations

Recover process catalyst for in-process reuse (12)(17)

Consider fixed bed catalyst technology. This eliminates the need to filter catalyst from the process stream

Investigate using improved baffling in reactors or other vessels to improve mixing

Investigate using radial flow turbines in reactors or other vessels to improve mixing (11)

Investigate the use of multipour-type mechanism that can divert more than one incoming conveying line to more than one discharge conveying line

Consider using vertical centrifuges that can remove container heels

Consider using sealless pumps for transferring, recirculating or agitating solvents and solutions (2) or secondary seal systems which can return powders or vapors for in-process reuse. See Chemical Processing, 10-96 pg 65-68.

Consider using impacting vibrators to remove clinging material from container walls, silo funnels, filter outlets, cyclones, pipelines and reactors to conserve product while minimizing the need to use chemical solutions to clean this equipment. See Chemical Processing, 1-98; pg 74-79.

Purchase tanks that have flanges that allow for full tank drainage

Upgrade metering/dispensing equipment (4)(12)

Use cam and groove couplings to reduce spills during coupling and uncoupling hoses, flanges etc.

Investigate catalyst-based water purification technology that may eliminate the need to use filters or chemical additives to destroy bacterial and viruses in water. (see Chemical Processing, 10-97,

page 164.) Also investigate ultrasonic water treatment technology to reduce energy consumption and waste

Investigate material/product screening systems that are designed to minimize or prevent plugging, blinding, product damage, and overscreen tailings

Combine reverse osmosis water treatment with existing deionization systems (13) (20)

Install flow restrictors on laboratory waste sinks to minimize waste generated from cleaning glassware (12)

For some applications investigate the use HEPA filters that do not contain aluminum screens; the screens become contaminated and are unrecyclable (21)

For some applications consider replacing carbon steel solvent storage tanks with stainless steel tanks to eliminate the need to use aqua ammonia for pH control (12)

Investigate installing upstream filters to extend downstream filter life or the useful life of carbon in water treatment units (7)

Use filter presses to remove excess process related water from wetcake or off specification product to facilitate in-process recycle

Use high performance gaskets, valves and seals to prevent/reduce leaks (17)

Use in-line oil filtration/purification equipment to extend changeout intervals for oils and hydraulic fluids (28) (37)

Consider installing water softening system to extend life of filters and reduce need for filter aid (7)

Consider flow control feeders that use Doppler radar technology

Use hoppers that breads arches and ratholes with movement

Consider incorporating strain-gauge sensor for continuous level measurement of skirted silos

Investigate integrated dewatering and drying systems

Investigate using portable analyzers to reduce waste sample sizes

Operational

Polish the inside of reactors to a mirror finish to facilitate cleaning

Use Teflon liners to reduce cleaning needed on mixing vessels and tanks

Reincorporate solvent containing wastewater from process production vessels in product manufacturing ingredients, or formulate a product that can use solvent washes as make up (11) (27)

Use statistical process control monitoring to predict expected equipment service life to replace equipment such that it does not fail during operation. Equipment failures during operation may generate off specification waste product (37)

Use very high pressure water washes (4000 to 10,000 PSI) to reduce cleaning or rinse waste. Also consider using spray cleaning wands and vaporizing temperatures in conjunction with line condensers which can reflux cleaning solutions (29)

To reduce waste from cleaning product transfer lines, first purge the lines using air pressure or a pipeline cleaning pig (11)

To reduce waste from moving material via transfer lines, use portable scales in conjunction with manual loading when possible (11)

Dedicate equipment to particular products (25) (29)

Use removable Teflon liners in conjunction with refillable high density polyethylene containers for chemical reagents to reduce glass container waste (13)

Consider ultrasonic cleaning of vessels

Consider cleaning methods including crushed walnut shell blasting, carbon dioxide pellet blasting, and hot nitric acid rinsing as alternatives to solvent cleaning

Consider modifying batch washing processes from crosscurrent to counter current washing (12)

Increase batch sizes (11) (12)

Agitating process mix ingredients outside the reaction vessel may help decrease temperatures of the vessel walls which affects buildup on the walls.

Use process wastewater for rinse cleaning of reactor or mixing vessels

Use removable drum liners to prevent contamination of containers

Investigate using dust baghouse filters that have removable cartridges

Revise quality control procedures (1)

Consider bulk raw material delivery systems and returnable totes (2) (26)

Consider, when safety is not a concern, manual precleaning of vessels, tanks etc., to reduce solvent or surfactants used for cleaning

Vacuum clean drums for reuse

Segregate metal dust from non metal bearing dust in floor sweeping and dust collection systems to facilitate in process recycle and keep hazardous waste from mixing with non hazardous waste (14,15)

Install roofs over waste solvent storage tanks to reduce rainwater accumulation in secondary containment zones (20)

Input substitutions

Use non hazardous flushing fluid for general maintenance of heat transfer fluid systems

In some applications, terpenes might be used as a solvent substitute for NMP

Investigate the use of non hazardous heat transfer fluids that when drained can be recycled or combined with oil that can be recycled, and that do not coat the chemical processing equipment system with baked on carbon deposits if overheated.

Investigate the use of synthetic oils and lubricants

Incorporate use of surfactant cleaners to replace hydrocarbon solvent cleaners (11)

Replace chromic acid anodizing with phosphoric acid anodizing (16)

Use heptane as a substitute for hexane and phosphorous trichloride (29)

Replace lead with tin as a sheathing material (38)

Product Reformulation

Use off specification product, or refine coproducts to make a lower grade primary product or

secondary product (11) (17)(18)(32)

Increase solids content in spray solutions used in product manufacturing (5)

Develop water-based primer to replace solvent-based primer (16)

VI. Case Study

This chapter of the report highlights the experience of a firm that achieved hazardous waste source reduction as a result of management commitment to continuous process and product improvement. These were the drivers that resulted in reduced waste generation. The documentation for SB 14 dovetailed with efforts that were already ongoing at this facility. SB 14 documentation for this facility was notable for two reasons: it reflected a particularly thoughtful and thorough effort to identify and evaluate source reduction measures, and it indicated that the facility went beyond the minimum requirements of SB 14 by examining ways to reduce all routinely generated waste streams regardless of their size

Monsanto

Monsanto's Avon facility team in Martinez, California produces a vanadium catalyst which is used to produce or reprocess sulfuric acid, a substance widely used in the fertilizer, metal smelting and petrochemical industries. Source reduction implementation at this facility reflected management's commitment to continuous improvement which is an important principle of Total Quality Management. (Note the separate publication: Monsanto Avon: the synergy between total quality and pollution prevention). Continuous improvement is also an important component of private sector environmental management system initiatives such as International Organization for Standardization or (ISO) 14000 and the Chemical Manufacturers Association's Responsible Care codes of management practices. This facility's experience illustrates that one of the outcomes of a continuous program of product/process improvement is the source reduction of waste. Continuous improvement occurs when facilities seek to maximize efficiency by actively seeking input from employees and customers, and using a disciplined systems approach to problem solving.

Starting in 1985, the Monsanto Avon facility formed employee teams to refine the vanadium catalyst manufacturing process with the goal of improving the plant's raw material yields. Many of the resulting improvements lead to significant reductions in hazardous waste generation. Since 1990, the first reporting year under the provisions of the Hazardous Waste Source Reduction and Management Review Act, the Avon Plant has increased production throughput by nearly 70 percent while reducing hazardous waste generation by nearly 90 percent.

An important part of the Avon plant's continuous improvement program is the application of Statistical Process Control (SPC). Processes are monitored for variations to identify statistically significant swings in raw material yields often correlated to waste generation rates. When measurements go outside control limits, a plant team will develop solutions to bring the system back within control limits. As stepwise improvements are made, narrowed control limits continuously improve product raw material yields and product quality.

Facility description

Vanadium catalyst manufactured at the Avon plant is more precisely characterized as potassium oxo-n

sulfato vanadate salts on a diatomaceous earth support medium, in the form of either solid cylindrical pellets or as raschig rings. Used in sulfuric acid reprocessing, the catalyst converts sulfur dioxide to sulfur trioxide; an intermediate step in the regeneration of spent sulfuric acid. The sulfur dioxide is produced when spent sulfuric acid is decomposed in high temperature furnaces. Petroleum refineries, which use large quantities of sulfuric acid in drying and alkylating operations return the acid to processors for cleaning and reconstitution via distillation. Following distillation, the acid is fortified with oleum to reach desired concentrations.

Catalyst process description

The vanadium catalyst production process begins when a powdered raw material is blended in a hopper with recycled off specification finished catalyst and intermediate material. After blending, this dry material is transferred to a dough mixer. In the dough mixer the preparation is sprayed with a pre-prepared vanadium pentoxide solution.

From the dough mixer the mixture transfers to the extruder, which extrudes the dough as wet solid pellets or as raschig rings. The wet extrusions proceed to a steam heated dryer. The dried material discharges to an elevator which conveys it to the screener. This screen separates out chips and chunks which are ground and recycled back to the dry material blending hopper. Sized catalyst support media is then activated by treatment with heat in a chemical environment.

The activated catalyst is then discharged to the final product screener which removes dust, chips, and chunks. On-size materials are then packaged in steel drums, fiber drums, or supersacks for shipment.

Waste stream generation

Historically there have been three major routinely generated waste streams by the facility. By California Waste Codes (CWC), these waste streams include: catalyst fines, (CWC 141), trash contaminated with sulfuric acid catalyst fines (CWC 352), and trash contaminated with vanadium pentoxide (CWC 352). By far, catalyst fines have been facility's largest waste stream even though much of this material is internally recycled. Smaller waste streams have included empty aerosol spray cans, and hydrocarbon solvents.

Catalyst fines are generated from a several sources including dust escaping from the collection system, the finished catalyst discharge system, off-sized product. Other solid waste was generated from used drum and bag liners. Trash contaminated with vanadium pentoxide was generated primarily from vanadium pentoxide loading activities.

Generation of catalyst fines peaked at approximately 300 tons annually in 1982. By 1994 fines generation had decreased to approximately 25 tons. The facility also had almost doubled production when compared to 1982. The following section discusses facility improvements which resulted in reduced waste generation.

Extrusion conditions

Before the catalyst support media passes through the extruder it is blended with a catalyst solution to achieve a dough like consistency. Before the process modification was made, 30-40 percent of the extruded material ended up as broken catalyst support media. This high percentage of scrap overloaded the final media screen which caused the scrap to flow into the calciner. Because the process could not recycle all catalyst scrap, much of the scrap had to be shipped offsite for disposal as hazardous waste.

A study team discovered that less scrap was produced when the solution condition was optimized. To optimize conditions auxiliary equipment was installed. The scrap level from the process then decreased to only five percent of extruded material. As a result, catalyst fines generation dropped from 105 tons in 1987 to 80 tons in 1988. This \$5,000 dollar investment had a payback period of only 2.5 months.

Raw material percentage adjustments

The catalyst production process is divided into two major areas; the untreated catalyst support media and the finished product. The catalyst process has two in-process recycle streams. One recycle stream feeds off-sized finished material that has been reground to the untreated catalyst support media side. However, the amount of the material transferred to the untreated side was limited because of chemical characteristic which negatively impacted the efficiency of the extrusion process. To help resolve this problem, the ratio of solution to the dry ingredients was adjusted and a new ingredient was added. This change held the generation of catalyst fines at the same level comparing 1993 to 1994, even though production increased by 45 percent over the same time period.

Product transport

Untreated pellets or rings discharge from the dryer to a chute that has a carbon steel surface. The distance between the dryer discharge and the chute is approximately 10 feet. This fall combined with the surface hardness resulted in a noticeable portion of the pellets being broken. To reduce pellet breakage, which generated catalyst fines, sheets of gum rubber were attached to the chute's impact surfaces..

Dust collection system

The ventilation system in the final product packaging station area filters dust (catalyst fines) from the plant's atmosphere to improve industrial hygiene. This system also prevents dust build up in the final product. Dust collected by the unit's filter bags is stored for recycling. When the dust level exceeds the system's limited recycling capacity the excess dust is diverted to a storage hopper for waste disposal. However, this design posed three problems: 1) low air flow velocity in the system provided inadequate ventilation, 2) per batch recycling rates were highly variable due to inconsistent transfer of material from the collection hopper, and 3) the unit's filter bags had to be replaced annually; generating trash contaminated with catalyst fines. To remedy this conditions, a new unit filter was installed that contains Gortex[®] membrane bags which have a minimum five year service life. A vibrating bottom unit was added to the dust collection hopper to maximize dust transfer rates thus creating recycling rate

consistency. Lastly, duct work in the system was reconfigured to improve air flow velocity. After the system was installed, annual catalyst fines generation was reduced from 177,000 pounds to 76,000 pounds. Final product quality and consistency improved, particulate emissions decreased by 75 percent comparing 1991 to 1992, and dust exposure levels inside the plant significantly decreased. All of this occurred while production rates increased by 20 percent.

Product screening system

The prior screening equipment removed dust from the product hopper prior to packaging, but towards the end of the batch runs the accumulated dust overwhelmed these screens. These occurrences resulted in very dusty final lots of product which had to be set aside for rework. In addition, the operation for manually collecting and recycling this material generated dirty container liners for hazardous waste disposal. To solve this problem, a horizontally configured product transfer system was employed that uses vertically oriented dust removal screens. Facility personnel believes that the changed air flow orientation in this new configuration should be able to handle the wide variation in dust loading thus preventing the problem of saturated screens.

Dedicated lubrication system

The function of the lubricant filtration unit which serves two catalyst extruders is to remove solids contamination from the lubricant in each system's gear box. Increasing cartridge filter replacement frequency indicates that one of the gear boxes needs to be replaced. Unfortunately, the single filtration system does not provide a method to identify which mill gear box unit needs repair. As such, contaminated lubricant problems can require that both gear boxes be repaired. Each incident costs approximately \$7,000. The current plan is to install a separate filtration unit for each gear box. Benefits will include reduced maintenance costs, reduced oil filter replacement frequency and lowered waste oil generation.

Material transfer system

The vanadium pentoxide transfer system uses a blower which creates suction to draw material from product drums (now replaced by bulk supply totes) into a receiving unit which temporarily holds material for transfer to the storage hopper. At the bottom of the receiver is a rotary air lock valve that transfers the product from the bottom of the receiver unit to a pressurized transfer line which feeds the storage hopper. In addition to creating suction to pull material into the receiving unit, the blower also compresses the discharge airstream and channels it into a three inch diameter material transfer pipeline. At the top of the receiver unit there is a dust removal cartridge that filters the air before the blower moves it into the transfer pipeline. A continuous flow of pulsed compressed air supplied by the adjacent refinery was used to keep the cartridge from clogging. When the system was shut down pressure dropped and a spring actuated check valve closed. This valve was intended to keep any fugitive dust in the system's back flow air from affecting the blower. Before the system was upgraded however, the dust removal cartridge would occasionally become clogged. These events let dust leak into the material transfer line. At certain intervals, fugitive dust would reach a mass such that it would lead to blower

damage. When the blower was damaged, the system had to be repaired. Annual costs of these incidents was estimated to be \$6,000. A process improvement team studied the system and determined that there were two contributing problems leading to these incidents. The first problem was that the compressed air pressure supplied from the adjacent facility was too low to keep the dust removal cartridge continuously clean as was intended. A second problem was that the blower check valve did not effectively prevent back flow of fugitive dust/material in the transfer line from affecting the blower when the system was shut down. These problems were addressed in 1998 by installing a new plant wide air compressor system to replace the system which relied on the adjacent facility. This new system supplied air at a greater pressure. A second implemented improvement was to install a positive shut off valve that is actuated by an electrical signal to replace the passive shut off valve to more effectively prevent any leaked dust or transferred material in the back flow air from coming into contact with the blower.

Refining material blend ratios

The facility receives a powdered raw material in two grades. Each grade has different chemical and physical characteristics. Previous quality control management of these materials involved analyzing incoming loads and blending the two grades using a ratio to optimize cost savings. The blended material was then stored prior to use. Periodically however, the extrusion process produced excess off specification material outside of the system's control limits. Investigation revealed that the characteristics of the blended grade had changed in cases where the extruder produced excess off specification product. To solve this problem, the optimum blend ratio was established for each product, and samples are now taken at the point of feed to the process. This change reduced extrusion problems and improved catalyst quality. As a result, fines generation decreased from 38 tons in 1992 to 25.5 tons in 1993.

Alternative spray applications method

In past practice, aerosol spray cans were frequently used to apply paints or lubricants. However, empty cans contain residual compressed gas or compressed flammable gas and must be managed as hazardous wastes. Waste disposal costs and air quality considerations encouraged Monsanto to reduce the use of these cans. Current procurement policy gives preference to purchasing paints and lubricants in bulk quantities. When spray applications are needed, a refillable spraying unit that uses compressed air as the propulsion media is now used.

Moisture adjustment

During 1988, a new sulfuric acid catalyst product was developed which enables the conversion of sulfur dioxide to sulfur trioxide at lower temperatures leading to reduced sulfur dioxide emissions at sulfuric acid plants. However, this new product generated about 15-20 percent support media scrap by weight. A production and engineering team discovered that by adjusting one of the extrusion process parameters the production rate could be doubled while reducing the scrap rate down to one percent by weight. The net effect of this change was to reduce per unit production costs by 40 percent.

Housekeeping

The replacement of clay base absorbent (that can absorb oil up to 20% of its weight) with cellulose base absorbent that can absorb oil up to 100% of its weight, should reduce the quantity of trash contaminated with lubricants generated during the cleanup of oil leaks or spills.

Returnable containers

To eliminate the handling safety related concerns and the waste associated with fifty-five gallon vanadium pentoxide drums, returnable totes are now used to receive and unload this material. This improvement eliminated the generation of used drum liners which had to be disposed of as extremely hazardous waste. The tote handling system that replaced the drum system also reduced plant technician s exposure to vanadium pentoxide and eliminated the ergonomic hazard created from manually handling 440 pound drums.

Conclusion

Since the early 1980 s the Monsanto Avon plant s total quality approach has produced multiple benefits. These benefits have positively affected customers, plant personnel, production economics, and the environment. Environmental quality has improved because the facility has realized significant reductions in waste generation and air emissions. During a long period in which production throughput at the facility has steadily risen (1987-1996) per unit production costs have declined, and costs and potential liabilities associated with waste disposal have been significantly reduced. Source reduction implementation played an important role in realizing these benefits. The Monsanto Avon plant s experience clearly demonstrates that source reduction opportunities at a chemical and allied products manufacturing operation can be identified, evaluated, and implemented as part of a comprehensive approach which focuses on continuous product quality improvement.

VII. Conclusion

The two year source reduction planning review of 40 California companies classified as Chemicals and Allied Products industry firms yielded both positive and negative findings. On the positive side, many firms in the industry have implemented source reduction measures. On the negative side, the findings also indicated that a majority of these companies had problems in meeting the requirements specified in the Hazardous Waste Source Reduction and Management Review Act (SB 14). The problems ranged from administrative errors to analysis and documentation deficiencies such as lack of adequately addressing evaluative criteria for specific source reduction opportunities. In these latter cases, baseline measurements quantifying waste generation at the sources producing major waste streams were often absent. A related problem was that many firms were not able to show estimates of waste reduction from implementing measures and did not estimate, or adequately address the economics associated with source reduction opportunities listed for consideration in their documents.

Among the sample of firms reviewed for this report, some companies allocated resources to the SB 14 review process and achieved noticeable results. For other firms, source reduction Plans and Report documentation indicates that minimal effort was expended to consider and implement source reduction measures. This latter group of companies may have viewed the SB 14 as a paperwork exercise and it appears that company management was not committed, involved, or willing to allocate resources to the effort. Many of these same companies however, indicated that they had waste reduction or waste minimization policies in place at their facilities. The poor documentation in source reduction Plans and Reports submitted by these firms did little to create confidence that these policies yield results. In order to benefit from SB 14 management support is essential. If industry created programs such as the Chemical Manufacturing Association's Responsible Care codes of management practice and International Organization of Standards ISO 14000 are to be perceived as more than public relations, then clearly firms must improve compliance with, and also appreciate the potential benefits of, laws such as SB 14.

When chemical industry companies dedicated resources towards reducing air emissions (given the challenge from the US Environmental Protection Agency (EPA) coupled with public information disclosure) by enrolling in EPA's 33/50 program, great progress was made. In fact, many of the company's exceeded the goal of reducing emissions of one or more of the 33 types of air contaminants of concern by 50 percent. The same degree of dedication and commitment is needed to accomplish significant industry reductions in hazardous waste generation. The case study included in this report illustrates that companies with progressive mindsets that focus on continuous process and product improvement, employee involvement, and environmental stewardship find SB 14 both successful and compatible with those efforts.

DTSC has discussed industry compliance problems with many of the firms reviewed in this report, and also met with the Chemical Industry Council of California to provide an overview of what is needed to make SB 14 work for the industry. The firms mentioned in this report have a new opportunity in 1999 to reorganize their SB 14 planning effort. If companies allocate sufficient resources and conduct the SB 14 review in earnest, programs like Responsible Care will achieve the results and goals that were intended, and the validity of these programs will be greatly strengthened.

APPENDIX A

Sample SB 14 document request letter from DTSC

Ms.
Criterion Catalyst
1001 N. Todd Avenue
P.O. Box 1356
Azusa, California 91702

HAZARDOUS WASTE SOURCE REDUCTION AND MANAGEMENT REVIEW ACT OF 1989 - SENATE BILL 14

Dear Ms.:

The Hazardous Waste Source Reduction and Management Review Act of 1989 (SB 14) requires facilities that generated over 12,000°kilograms (13.2 tons) of hazardous waste or 12 kilograms (26°pounds) of extremely hazardous waste in 1994, and each reporting year (which occurs every four years), to prepare two documents and summaries of each. Hazardous waste quantity in the reporting year includes hazardous waste that is recycled onsite or offsite, treated onsite, (including hazardous wastewater that is treated prior to POTW discharge), and manifested offsite. For the first document, the Source Reduction Plan (Plan), the business identifies all routinely-generated hazardous waste streams at the generator s site and evaluates major wastestreams for the potential to reduce waste at the source(s) that generate the waste. In the second document, the Management Performance Report, the business describes hazardous waste management methods, and assesses the effectiveness of any past changes implemented in those methods, including source reduction measures, recycling, and treatment activities.

Under the authority granted in Health and Safety Code (HSC), Section 25244.18, the Department of Toxic Substances Control (DTSC) is hereby requiring that copies of the Plan and Management Performance Report for Criterion Catalyst located at 1001 N. Todd Avenue, Azusa, California (EPA ID # CAD008344228), be sent in for review. Please include the Progress Report as specified in Title 22, California Code of Regulations (CCR), Section 67100.12 (this is Form GM from the 1995 U.S. EPA Hazardous Waste (Biennial) Report). Please mail copies of these documents to the following within 30 days of receipt of this letter:

Mr. David Weightman
Office of Pollution Prevention
and Technology Development HQ-25
Department of Toxic Substances Control
P.O. Box 806
Sacramento, California 95812-0806

Ms.

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Failure to submit these documents within the specified time frame may result in civil penalties of up to \$1,000 per day as specified in SB 14.

We look forward to your cooperation in this matter. If you have any questions regarding this letter, please contact me at (916) 445-2926. Thank you.

Sincerely,

David Weightman
Office of Pollution Prevention
and Technology Development

APPENDIX B

Source Reduction Plan - SAMPLE TECHNICAL CERTIFICATION STATEMENT

I _____ certify that the attached Source Reduction Review and Plan, prepared under the provisions of the State of California's Hazardous Waste Source Reduction and Management Review Act of 1989:

- 1) Addresses each routinely generated hazardous waste stream as specified in Title 22 California Code of Regulations (CCR) Section 67100.5(h).
- 2) Addresses the five categories of source reduction approaches (for major routinely generated wastestreams) specified in Title 22 CCR Section 67100.5(j).
- 3) Clearly sets forth the measures to be taken with respect to each hazardous waste stream for which source reduction has been found to be technically feasible and economically practicable, with timetables for making reasonable and measurable progress, and documents the rationale for rejecting available source reduction measures.
- 4) Does not merely shift hazardous waste from one environmental medium to another environmental medium by increasing emissions or discharges to air, water, or land.
- 5) Specifies a 4 year (percentage) goal for hazardous waste source reduction that is based on anticipated implementation of measures chosen in the source reduction Plan.

MANAGEMENT PERFORMANCE REPORT SAMPLE TECHNICAL CERTIFICATION STATEMENT

I _____ certify that the attached Management Performance Report prepared under the provisions of the State of California's Hazardous Waste Source Reduction and Management Review Act of 1989:

- 1) Contains an estimate, in pounds, of the quantity of hazardous waste generated and the quantity of hazardous waste managed, both onsite and offsite, during the current reporting year and the baseline year as specified in Title 22 California Code of Regulations (CCR) Section 67100.8(a)(3)(A).
- 2) Identifies and discusses the factors that have affected both hazardous wastestream generation and hazardous wastestream management since the baseline year of the previous Plan and Report, or the baseline year chosen for the initial Plan and Report.
- 3) Describes the management (waste disposition) methods used at the site for routinely generated wastestreams generated during the most recent reporting year as specified in (CCR) Title 22 Section 67100.8(a).

APPENDIX C

SB 14 SOURCE REDUCTION PLAN COMPLETENESS AND REVIEWER COMMENTS CHECKLIST (check all that apply)

Site/Company: _____

A. Facility Information (CCR sections 67100.5(a through f))

- ☐ Your Plan included the following required facility specific information: Company Name, facility address(es) , business 4-digit Standard Industrial Classification (SIC) code, time the company has been in business at site, and the number of employees working at the site.
From the above list _____ was not included in your Plan

- ☐ Other comments _____

B. Business Activity (CCR section 67100.5(e)) See Page 15 of the Guidance Manual for more information

- ☐ Your Plan adequately describes the nature/type of the business operating at the site.
- ☐ The reviewer felt that the nature/type of business operating at the site could be better described and understood if:
- ☐ Your Plan indicated what customers/markets purchase your company s products.
- ☐ Your Plan indicated how the products produced by your business are used.
- ☐ Other comments _____

C. Process and Operations Description(s) (CCR Section 67100.5(g))

- ☐ Your Plan s description of your business s activities provided an adequate overview of the plant s overall operations i.e., clearly describing the important steps involved in manufacturing the products produced at the your facility.
- ☐ Your Plan, does not describe, or does not adequately describe the major process steps and activities which are associated with producing your plant s product(s) or product categories.
- ☐ Your Plan does not include a general overview of plant operations.
- ☐ Other comments _____

D. Waste Generation (CCR Section 67100.5(c)) Page 18-23 of the Guidance Manual

- ☐ Your Plan describes the source(s) of each major routinely generated hazardous waste stream.

- ☐ Your Plan does not explain why routinely generated waste streams are produced.
- ☐ This applies to all routinely generated waste streams
- ☐ This applies to the following routinely generated waste streams:
-
- ☐ Your Plan discusses waste generation by combining waste streams that are classified under the same California Waste Code type.
- ☐ Identifying and evaluating source reduction alternatives for several waste stream sources [which fall under the same Waste Code category] is viable because the sources that generate wastes are similar and the constituents of the waste streams are similar.
- ☐ This approach limits the scope and number source reduction options which can be evaluated for feasibility. Source-specific options need to be considered because the processes, operations, or activities [sources] which produce waste, and/or the waste constituents are unique even though the wastes are classified under the same California Waste Code.
- E. Block Flow Diagrams: (CCR Section 67100.5(i)(3)) Page 25 of the Guidance Manual; pages J6-J8 show examples of flow diagrams.**
- ☐ Your Plan's diagram(s) show the significant sources of waste generation and the quantities and the types or waste code categories for each significant source.
- ☐ Your Plan's diagram(s) show substance or raw material inputs and waste quantity outputs.
- ☐ Your Plan's diagram(s) do not show waste types and quantities by source. Your diagram(s) combine sources of waste into a box that represents all the processes, activities, and operations. This approach does not adequately describe waste sources on a process specific basis.
- F. Waste Generation Data (CCR section 67100.5(h) and (i)) Page 18-23 of the Guidance Manual**
- ☐ **Waste stream data in the Plan is:**
- ☐ Presented Correctly
- ☐ Incomplete or incorrect because:
- ☐ California Waste Codes are not shown for the listed waste streams
 - ☐ Waste constituents / or types not specifically identified
 - ☐ Total quantity of all routinely generated wastes not provided
 - ☐ Percentages for each routinely generated waste stream are not provided.
- ☐ Total quantity of routinely generated hazardous wastes has been incorrectly determined because:

- ☐ Aqueous hazardous waste streams discharged to POTW or through NPDES permit were not excluded from total quantity of routinely generated waste streams when determining nonaqueous major waste streams. (see page 19-20 of the Guidance Manual)
- ☐ Excluded waste category types such as asbestos, automotive fluids etc. quantities were included in total routinely generated waste quantity. (see page D - 3 for a list of excluded waste types)
- ☐ Waste quantities from nonroutine sources of waste generation were included in total routinely generated waste quantity.
- ☐ Waste generation from an event that occurs at intervals of greater than 1 year (and the event occurred in the reporting year (1994)) was not included or was not properly included. Prorate repeating event total and include that prorated amount in the total routinely generated waste total calculated for the reporting year. Prorate the amount based on the length of the time that typically occurs between events. For example, if the event occurs every two years, use one-half of the amount as an average annual generation rate for the reporting year.
- ☐ Percentages shown for routinely generated waste streams are incorrect:
 - ☐ This does not change which waste streams are identified as major
 - ☐ Additional wastestreams should have been identified as major waste streams and the sources of this waste should have been evaluated for source reduction opportunities.
 - ☐ To determine major nonaqueous wastestreams exclude - the quantity of hazardous wastewater which is treated - and then discharged to the wastewater treatment facility - and compute percentages of each nonaqueous waste stream source considering only the total of the non aqueous wastes generated at the facility.

G. SOURCE REDUCTION MEASURE IDENTIFICATION (CCR Section 67100.5(j-o)) Pages 26-27 of the Guidance Manual

- ☐ For major routinely generated hazardous waste streams your Plan identifies specific source reduction opportunities that could be characterized as:

(Note that definitions for the terms below can be found on page 37 of the Guidance Manual)

- ☐ Input substitutions ☐ Process modifications ☐ Operational changes
- ☐ Administrative changes ☐ Product reformulation
- ☐ Many of the five source reduction categories were addressed using statements such as NA/ or none available.

- ☐ These statements or assertions are explained
- ☐ These statements or assertions are not explained

- ☐ Specific source reduction measures were listed and described
- ☐ Specific source reduction measures were listed, but were not described
- ☐ Categories of source reduction approaches were listed for evaluation rather than specific measures to reduce waste generation from specific sources of waste generation.
- ☐ Measures were listed for evaluation which are not source reduction measures because they are actions taken after, rather than before a waste is generated. Please remove non source reduction measure discussion from the source reduction Plan and include this information in your Report.

Non source reduction measures in your Plan included:

- ☐ Reuse of waste for non product related production
- ☐ Recycling
- ☐ Steps to increase concentration or reduce the volume of waste (after its been produced) This might include secondary wastes such as sludge or filtercake etc. from a treatment process.
- ☐ Treatment of waste - steps to alter the physical, chemical or biological properties of waste. This can include incineration.

H. SOURCE REDUCTION MEASURE EVALUATION (CCR section 67100.(5)k))

Top of page 28 in the Guidance Manual lists seven criteria that should be addressed when evaluating source reduction measures.

- ☐ Your Plan s evaluation of alternative source reduction measures explained why each source reduction measure would reduce waste generation (or hazardous characteristics associated with the waste stream(s)), and specifically indicated what each measure would involve.
- ☐ Criteria used to evaluate source reduction options are adequately addressed. Waste reduction estimates were quantified for studied source reduction measures. For source reduction measure which involved monetary investment, economic costs and benefits were shown. Technical, health and safety, regulatory considerations, and impacts on other environmental media were, as applicable, discussed such that it is clear these criteria were thoughtfully or adequately considered.
- ☐ Many of the criteria listed under specific source reduction options being considered were inadequately addressed: .
- ☐ statements such as not applicable or none available were not explained
- ☐ Brief statements listed under the evaluative criteria for specific source reduction measure alternatives:

- ☐ are inappropriate or indicate misunderstanding of what the criteria means
- ☐ indicate only a cursory look at the criteria for the measure and are incomplete
- ☐ some of the criteria listed such as _____, _____, _____, _____ should be more adequately investigated, and the results of the investigation need to be discussed in your Plan.

Additional Comments:

- ☐ Your Plan used a non required matrix that was presented as the evaluation of source reduction measures
 - ☐ The matrix is correctly used to show the **results** of analysis. The actual analysis of measures is presented in the Plan s text which narratively discusses the measures and the criteria used to examine the feasibility of each measure.
 - ☐ Your Plan s matrix is inadequate to present source reduction measure evaluation. Your Plan lacks, or presents inadequate narrative discussion regarding the evaluation of source reduction measures. This critical information is needed to support and explain the basis for weights, scores, or statements presented in the matrix for each source reduction measure that was considered.
- ☐ It is unclear how the matrix was used as a decision making tool [its true purpose] for consideration of source reduction measures.
 - ☐ the numeric scale(s) used is/are not explained
 - ☐ the significance of the scores, or statements, assigned to criteria under specific source reduction measures is not explained.
 - ☐ the significance of total scores assigned to specific source reduction measures is not explained.
- ☐ The rationale for choosing feasible source reduction measures to implement is clearly expressed in your Plan.
- ☐ Anticipated waste reduction from implementing measures is listed as low, high, or medium or other similar designations; however, the scope or meaning of these terms is unclear.
- ☐ Your Plan uses terms like study, determine or investigate feasibility when discussing source reduction options. The purpose of the Plan is to document the results after studying measures to determine if they are feasible.
 - ☐ Your Plan needs to explain why additional study is needed for listed source reduction measures i.e., discuss what information has been gathered as of the date of providing your Plan for review. Discuss what additional information is needed for decision making.
 - ☐ Your source reduction implementation schedule/timetable should indicate when certain tasks

associated with studying/determining feasibility/investigating are anticipated to be completed.

☐ The rationale for rejecting certain source reduction measures is clearly explained in your Plan. (CCR 67100.5(o))

☐ The rationale for rejecting certain source reduction measures is unclear.

I. Source Reduction Measure Implementation Schedule/Timetable (CCR Section 67100.5(p)) Pages 31-32 of the Guidance Manual.

☐ Your timetable clearly indicates when your company plans to implement feasible source reduction measures.

☐ Your timetable does not indicate dates or quarterly time periods for planned implementation of chosen source reduction measures and should be revised accordingly.

☐ Your Plan does not contain a chosen source reduction measure implementation timetable.

J. Certification Statements (CCR Section 67100.13(a) and (f)) Pages 50-52 of the Guidance Manual

☐ Your Plan is properly certified; financial and technical certification statements are distinguished separately and signed appropriately.

☐ Your Plan lacks a _____ certification statement.

☐ Your certification statements are not signed

☐ I recommend that each of your certification statements be labeled.

☐ Sample technical certification statements for both the Plan and the Report are enclosed with this checklist

K. Source Reduction Goal - (CCR Section 67100.5(q)) Page 39 of the Guidance Manual

☐ Your Plan contains a four year waste source reduction target (percentage goal) which represents potential source reduction accomplishment given successful implementation of all the Plan's chosen source reduction measures - and other measures you may examine during the four year planning period.

- ☐ The basis for your stated four year source reduction goal is unclear.
- ☐ Your source reduction goal is presented as several goals depending on the waste stream type. Your Plan should combine the effect of implementing all the chosen source reduction measures and estimate a single source reduction goal that reflects reduced quantity of all routinely generated hazardous waste. This goal should take into account anticipated change in production throughput.
- ☐ It is unclear if your source reduction percentage goal takes into account anticipated changes in production rates or other factors which can affect waste generation
- ☐ Your Plan does not contain a 4-year numerical goal for source reduction of total routinely generated hazardous waste streams. This is a requirement. Please refer to the Guidance Manual - the pages noted above

L. Trade Secret Claims (CCR section 67100.14) Page 53 of the Guidance Manual.

- ☐ No comments, or not applicable
- ☐ Comments regarding sections of documents marked confidential or trade secret

M. Progress Report (CCR 67100.12(a) and (b)) Page 41 of the Guidance Manual

- ☐ No comments
- ☐ **Progress Report** (form GM from the US EPA Hazardous Waste Report). One form should be filled out for each major routinely generated hazardous waste stream. This applies to RCRA and California only hazardous wastes.
- ☐ Contact DTSC at (916) 322-3670 to get the forms you need to complete this required element of your SB 14 documents.

MANAGEMENT PERFORMANCE REPORT COMPLETENESS AND REVIEWER COMMENTS CHECKLIST (check all that apply)

Company for which documents are being reviewed

A. Facility Information (CCR sections 67100.8(a through f))

- ☐ Your Report included the following required facility specific information: Company Name, facility address(es) , and business 4-digit Standard Industrial Classification (SIC) code.
- ☐ From the above list _____ was not included in your Report.

☐ Other comments _____

B. Baseline and Reporting years (CCR section 67100.1(c)) Page 45 of the Guidance Manual

☐ Your Report clearly indicates the baseline year.
(the baseline year should be the reporting year used in the source reduction plan prepared four years ago. If this is the company's first time with SB 14, the baseline and the reporting year can be the same, or the baseline year can be any year previous to the reporting year for which there is complete waste generation data)

☐ Your Report should be revised to indicate the baseline year. **(bottom of page 45 in the Guidance Manual)**

☐ Your Report clearly indicates the reporting year. **(page 45 of the Guidance Manual)**
(for most companies this should be 1994. However, if a firm made major changes, which mean that 1994 waste data is no longer representative of operations, then using 1995 or 1996 as the reporting year could be acceptable. If 1994 is not used as the reporting year, the Report should explain why)

☐ Your Report should be revised to indicate the reporting year.

C. Waste generation data (CCR section 67100.8(a)(3)(A)) Page 44-45 of the Guidance Manual

☐ Your Report describes the routinely generated hazardous wastes discussed in the source reduction Plan.

☐ Your Report is incomplete in describing the routinely generated hazardous wastes discussed in the source reduction Plan.

☐ Your Report shows the amounts of each routinely produced waste stream generated in both the reporting year and the baseline year.

☐ Your Report needs to be revised to show waste generation quantities for each routinely generated waste stream in the: ☐ Baseline year ☐ Reporting year ☐ Baseline and Reporting years

D. Waste stream management methods (CCR section 67100.8(a)(3)(A) and (B)) Page 44-45 of the Guidance Manual

☐ For each waste stream routinely generated at the business site, your Report indicates the reporting year quantity of the waste stream according to the method in which the waste is managed (handled) after its been generated.

☐ Your Report does not clearly indicate how each routinely generated waste stream (by reporting year quantity) is currently managed (handled) after its been generated. Your Report should be revised to include this required information.

- ☐ Management of waste streams could include: off site disposal, on site disposal, on site or off site incineration, on site discharge to the local wastewater treatment facility, on site or off site recycling, or on site or off site energy use (if the waste is used as fuel/fuel blending, the most correct description of this management approach would be energy recovery), or some combination of approaches might be used for certain waste streams.

E. Waste generation: comparison between baseline and reporting years
(CCR section 67100.8(a)(3)(D))

- ☐ Your Report discuss the factors which explain the differences in quantities of waste produced for routinely generated waste streams, comparing the current reporting year with the baseline year used in the previous source reduction Plan.
- ☐ Typical factors that could affect waste generation when comparing the different time periods might include: Success or non success implementing source reduction measures during the past four years, changes in production amounts, reclassifying the waste by changing the California Waste Code designation to a more representative waste code category, receiving material from closed facilities which ended up as waste because it couldn t be sold, new products being made, old products no longer being produced etc.
- ☐ Your Report should be revised to include discussion regarding the factors which have affected changes in quantities of waste produced for routinely generated waste streams comparing the current reporting year to the baseline year used for the previous source reduction Plan.

F. Waste stream management: comparison between baseline and reporting years (CCR section 67100.8(a)(3)(C)) Page 46-47 of the Guidance Manual

- ☐ As applicable, your Report discusses the nature of any changes made in the way particular routinely generated waste streams are handled (management methods) when comparing the reporting year period with the baseline year used in the previous source reduction Plan.
- ☐ Your Report needs to be revised to discuss the changes made in the way the following routinely generated waste streams are handled (management methods) when comparing the reporting year period with the baseline year used in the previous source reduction Plan. The waste streams are _____
- ☐ Since no changes were made in the method(s) by which routinely generated waste streams are managed, when comparing the current reporting year with the baseline year of the previous source reduction plan, comparison of waste stream management methods between the two time periods does not apply to your Report.

G. Certification Statements (CCR Section 67100.13) Pages 50-52 of the Guidance Manual

- ☐ Your Report is properly certified; financial and technical certification statements are distinguished separately and signed appropriately.

- ☐ Your Report lacks a _____ certification statement.
- ☐ Your certification statements are not signed
- ☐ I recommend that each of your certification statements be labeled.
- ☐ Sample technical certification statements for both the Plan and the Report are enclosed with this checklist

Optional Comments/Suggestions

Document Formatting

Was a Table of Contents provided?

- ☐ Yes
- ☐ No. This would help the reader find information that is required by SB 14 if it could be included when making revisions to your documents.

Were pages numbered?

- ☐ Yes
- ☐ No. To facilitate reference to items in your documents I recommend that these be added. I have hand numbered pages. Page number 1 starts with your Plan s _____

Are headings provided in the sections which indicate what the document sections covered?

- ☐ Yes
- ☐ No.

Are tables, charts or illustrations complete and easy to understand?

- ☐ Yes
- ☐ The organization of data in the documents could be improved to help readers better understand summary information.

Are the documents organized such that there a logical progression of ideas and information presented?

- ☐ Yes
- ☐ No. The order of information presented in your documents does not follow a logical progression
- ☐ No. Required information in the Plan and Report is not included in the Plan and Report. However, required information is included in Appendix instead of each document. This format makes it difficult to determine completeness of each document. This also confuses the deliniation between the two documents and the summaries of each document.
- ☐ No. The documents (Plan and Report) are merged into one document. There should be a clear separation between these two documents.



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